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CONTENTS OF THIS NUMBER

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The Editor's Monthly Talk

LEADING men in the mechanical field predict that we are entering upon a new era in production, that competition will be keen, and that as wages, freight rates and manufacturing costs generally are high, industry must find ways to bring down the unit cost. Some of this reduction in cost may come through greater efficiency of labor, but in large measure it must come through the adoption of more efficient mechanical equipment and shop methods. Automatic and semi-automatic machines will find an ever-increasing field. The less skilled labor a machine requires for its operation, the greater will be its value in the years of high-tension activity sure to come.

The automatic machine must not only perform the machining operations without the attention of an operator, but must be so designed that it will automatically feed the work to the cutting tools as well, and discharge the finished article with a minimum of attention from the costly human element. The recognition of this important factor has led to highly developed designs of magazine feeds through which the work is passed to the cutting tools with speed and precision. These mechanisms constitute an important part of the equipment in the modern machine shop devoted to quantity production. Their design and operation are of great importance. Some highly developed mechanisms of this type are described in the leading article in this number of MACHINERY—"Magazine Feeds for Automatic Screw Machines."

Production Control

In the small shop, where the superintendent can keep in close touch with the progress of each job, a system for production control is hardly necessary. But as the plant increases in size, the problem of supervision of production increases in difficulty. In large plants manufacturing typewriters, sewing machines, automobiles, vacuum cleaners, electric motors and a score of other machines and devices in large quantities, it would manifestly be impossible to maintain an even flow of production through the plant, keeping to predetermined production schedules, without a carefully devised and reliable system enabling the production manager to ascertain with accuracy, at any moment, the actual progress in the shop.

An effective system for this purpose is that of the American Multigraph Co., Cleveland, Ohio. A complete description of this system, showing all the forms and blanks used in connection with it, will be found in this number of MACHINERY. The description is accurate and authentic, being based upon an interview with Mr. R. G. Pack, vice-president in charge of production, who has personally checked this detailed account.

A series of articles dealing with practice in railway shops begins in April MACHINERY. It is a well-known fact that very few of the railway shops are equipped with modern tools for the work they have to do. There are some good railway shops, however, and their efficiency stands out by comparison. It is not from choice that railway mechanical executives use antiquated equipment. On the contrary, they are as alert and efficient as executives found in other lines. The fault lies in general railway organization and routine—but that is not a problem for us.

Methods in Railway Shops

In the series on railway shop practice beginning in April, MACHINERY will describe practice which, in general, meets the requirements for up-to-date methods. These articles will contain information of definite value to railway executives, especially in regard to the class of equipment that should be found in every railway repair shop. They will show good examples of modern railway shop practice, and it is to be hoped that good practice will spread. The railways pay hundreds of millions of dollars a year for locomotives and other rolling stock, and then, generally speaking, depend upon out-of-date and inefficient shop equipment to maintain this expensive equipment in working condition. True economy dictates the installation of the latest and most efficient tools and machines available. It is high time that the railway machine shop was put on a modern low-cost production basis. That is the way to keep the modern rolling stock in condition at all times.

Besides the articles mentioned, March and April MACHINERY will offer a variety of interesting articles gathered from many sources in the mechanical field. In the present number there are descriptions of die constructions for blanking and drawing purposes, in addition to the manufacturing articles dealing with the making of precision bench lathes, jigs and fixtures, tractor engine plant practice, planer practice, drill chuck manufacture, etc. In April MACHINERY, besides the leading article on railway shop practice, numerous phases of machine shop practice and design will be dealt with as usual. There will be no less than fourteen principal articles, in addition to the many letters on practical subjects, articles relating to domestic and foreign machinery trade, shop kinks, etc.

Mechanical practice steadily grows and widens. There is an incessant flow of new machines, tools and devices. To keep its many readers—scattered all over the world—accurately informed on these new developments, is the inspiring task of the engineering journal.

Magazine Feeds for Automatic Screw Machines

Special Equipments Developed by the Cleveland Automatic Machine Company, for Handling Second-operation Work

IT is a matter of general knowledge among men in machine shops that automatic screw machines are employed for the production of duplicate pieces, without requiring attention from an operator until such a time as the supply of stock is exhausted. For the usual operations on bar stock, provision is made in the design of the machine for feeding the work to the tools; but when it comes to the performance of second operations on pieces that have been cut off from the bar after completing the first sequence of cuts, special means have to be provided for economically loading successive pieces of work into the chuck for performing the second sequence of operations. If an automatic screw machine is to approximate its maximum efficiency on such work, it is necessary to furnish a magazine to deliver successive pieces of work automatically to the chuck, because a large part of the benefit resulting from automatic control of the cutting tools would be lost if the operator had to set up and remove each piece of work by hand.

In order to employ an automatic screw machine for a second operation on parts that have been cut off from the bar, it is necessary to provide an equipment for delivering successive pieces to the chuck, without requiring attention from the operator. Unless such provision is made, the machine is unable to function in a way that enables advantage to be taken of its automatic operating feature. For several years, the Cleveland Automatic Machine Co. has made standard types of magazine feeds for use on machines of its manufacture, which have previously been described in these pages. In the present article, an account is given of special magazines designed and built by this firm for handling unusual pieces of work for which magazines of the standard designs are not adapted.

Recognizing this fact, the Cleveland Automatic Machine Co., Cleveland, Ohio, started a number of years ago to develop magazine feeding mechanisms that are adapted for handling some of the various classes of work done on automatic screw machines of this company's manufacture. Some of these devices are of essentially standard design, a case in point being the so-called "tilting rotary" magazine, shown in the heading illustration of this article, that is used for carrying cylindrical shaped pieces of work to the chuck. Evidently there are a vast number of pieces of this kind which could be handled on automatic screw machines, and by having a magazine consisting of an endless conveyor chain by which pieces of work are carried around to the work-spindle, with means for transferring the work from the carrier to the chuck, and for ejecting the finished pieces, it will be evident that high rates of production should be secured. A benefit of this type of magazine is that there is a wide variety of cylindrical shaped pieces of work to be machined, and by simply equipping the conveyor chain with carrier bushings of the proper size, the same magazine may be adapted for handling a variety of pieces.

This is by no means the only case in which a magazine may be adapted for handling more than one class of work, but the example is typical. Several special types of magazine feeding mechanisms have been developed by the Cleveland Automatic Machine Co., in order to adapt automatic screw machines of its manufacture for handling unusual jobs. These magazines are described in the present article, not only because they are of rather unusual mechanical interest, but also because of the possibility of advantageously employing similar methods for other machining operations.

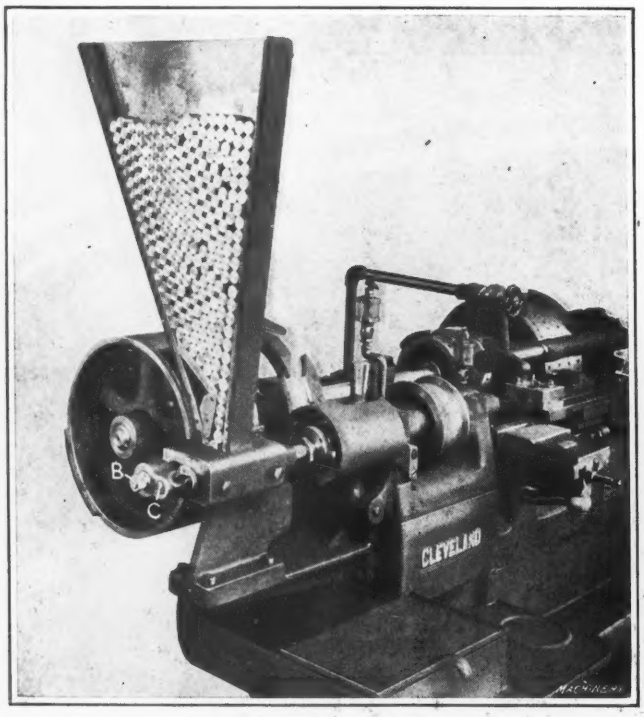


Fig. 1. One-half-inch Automatic Screw Machine equipped with a Magazine Feeding Mechanism for delivering Chain Bushing Blanks to the Chuck for performing a Drilling Operation

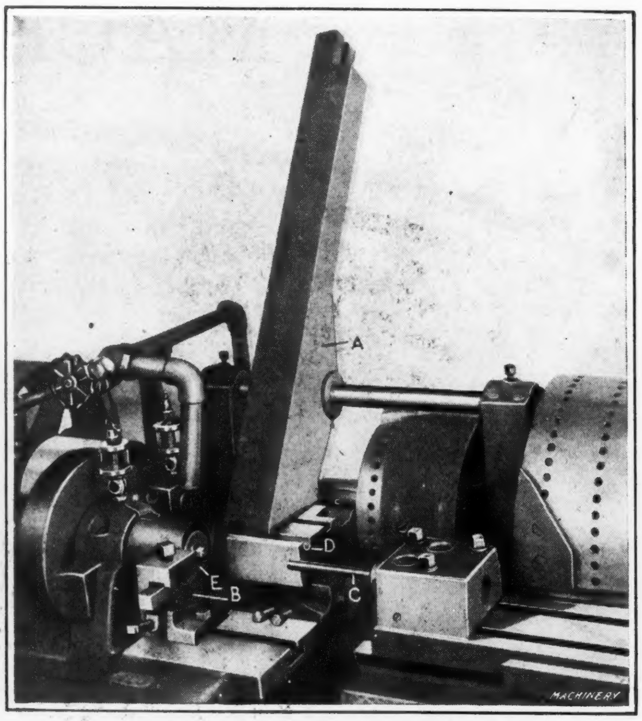


Fig. 2. Five-eighth-inch Automatic Screw Machine equipped with a Feeding Magazine for delivering Bolt Blanks to the Chuck for performing a Shaving Operation on the Head

Magazine Feeding Mechanism for Delivering Chain Bushing Blanks to the Chuck

At the plant of the Spaulding Chain Co., in Bloomfield, N. J., a ½-inch Model B Cleveland automatic is used for the performance of a second operation on chain bushing blanks. As these pieces come to the machine they have been turned, faced and cut off to length, and the second operation consists of drilling a hole through the bushing. Fig. 1 illustrates the magazine furnished for the machine on which this drilling operation is performed, and in Figs. 3 and 4, the arrangement of the feeding mechanism is more clearly shown. In this case, the magazine is made with two compartments, each of which is kept filled with blanks; in Fig. 1 one of the side plates has been removed in order to illustrate the way in which the blanks are stored in the magazine.

It will be evident that the hopper is carried by a bracket mounted at the left-hand end of the machine, where it is conveniently located in relation to the drum on which cams are mounted for actuating a plunger that pushes the blanks through a feed-tube to the chuck, in which successive blanks are held for drilling with a twist drill carried on the milling slide. Referring to Fig. 3, the arrangement of the mechanism is as follows: Located behind the magazine there is a cam-roller *A* that runs in contact with a cam carried on the drum shown in Figs. 1 and 3. The stud that carries roller *A* extends through a slot in the frame, so that it is free to move laterally through the cam action. This stud is carried by a bar *B* coupled to a plunger *C* that provides for pushing the blanks through a guide tube *D* to the chuck *E*. Contained in the coupling between bar *B* and plunger *C*, there is a spring compensator *F* that provides for taking up any slight difference which exists in the lengths of the blanks.

Operation of the Transfer Mechanism

In designing the cams for operating this mechanism, a double-action cam was provided for actuating the blank-feeding plunger, and the sequence of operations is as follows: Cam-roller *A* moves plunger *C* forward to advance one blank into the chuck; and then the cam which controls the movement of the milling slide, feeds the drill forward to

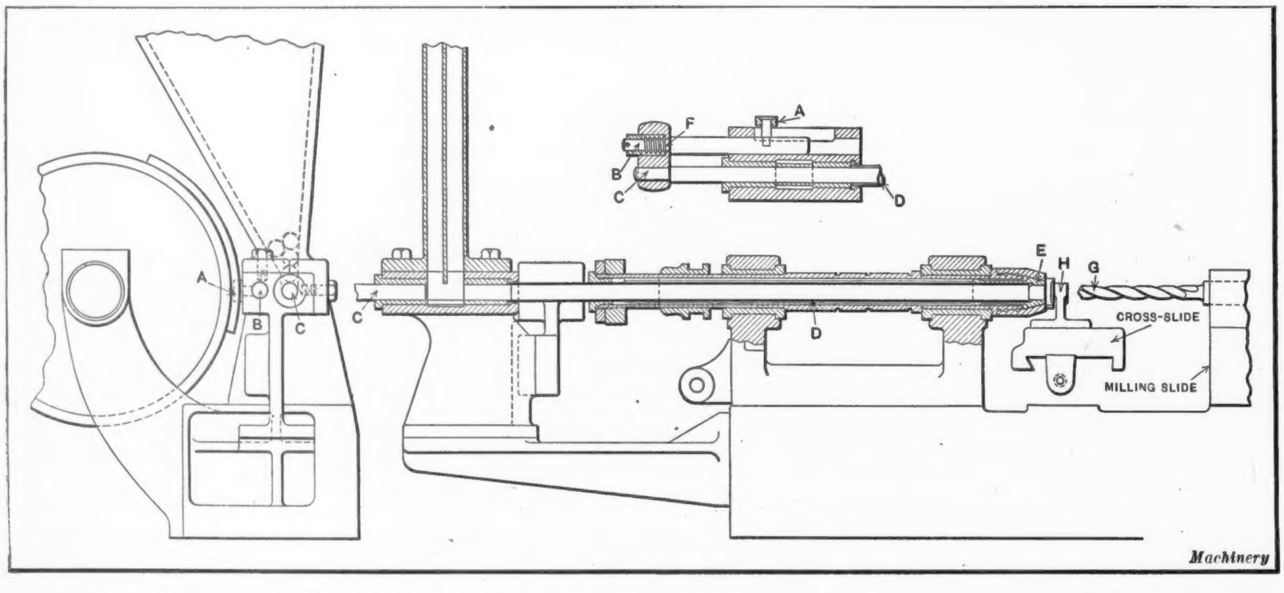


Fig. 3. Mechanism of Feeding Magazine shown on the Machine in Fig. 1. This Magazine is mounted at the Left of the Spindle Head, and a Cam-operated Plunger pushes Blanks through a Delivery Tube to the Chuck

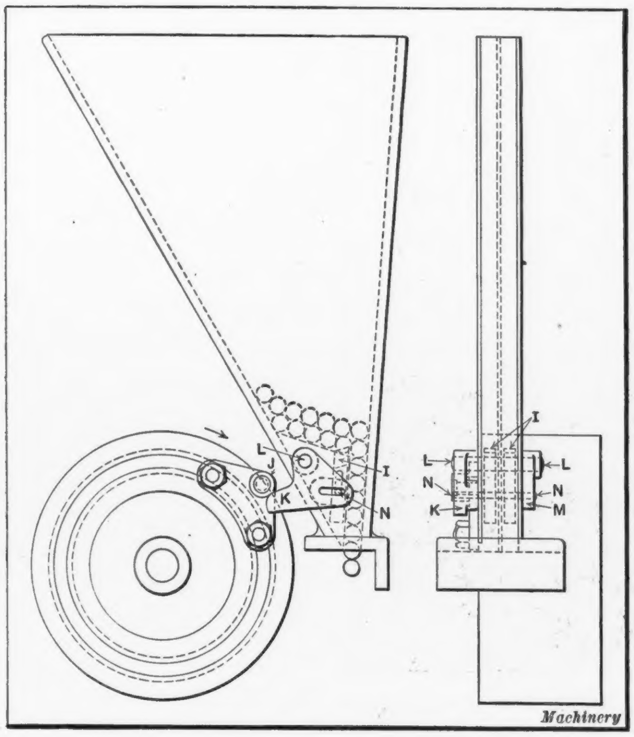


Fig. 4. Agitator which keeps Chain Bushing Blanks running freely through the Magazine shown in Figs. 1 and 3

produce the required hole in this bushing. After the drill recedes, the cam running in contact with roller *A* has a second rise which continues the forward movement of plunger *C* to bring a second blank in place for drilling.

After drill *G* has been advanced to drill this piece and has receded, the cam and roller *A* withdraw plunger *C* to its starting position, so that two more blanks may drop from the hopper into the pocket that is in line with the guide tube *D*. It will be apparent that as plunger *C* pushes the blanks forward into the feed-tube, it also serves the purpose of a stop which holds the remaining blanks up in the hopper of the magazine, and the pushing forward of one blank into place in the chuck provides for the ejection of the previously drilled bushing. Endwise location of each bushing blank in the chuck is accomplished by means of a gage-stop *H* which is carried on the cross-slide; and the camming is so arranged that at the same instant that a bushing drops out of the chuck, stop *H* slides across the face of the chuck and checks the forward movement of the undrilled blank, when it has reached the proper position between the jaws. The guide tube *D* is kept full of blanks so that the complete stroke of plunger *C* is only slightly in excess of the length of two blanks.

Arrangement of the Agitator

In all forms of magazine feed mechanisms where there is any danger of the blanks failing to run freely from the hopper to the chuck in which they are held for machining, some form of agitator must be used to assure the continuous feeding of work. Fig. 4 illustrates the device used on the magazine shown in Figs. 1 and 3. It will be seen to consist of a block *I* contained in each of the compartments of the hopper, which is agitated up and down by a cam mechanism to prevent danger of having the blanks become blocked at the entrance to the channel through which they run down to the guide tube that carries them over to the chuck. Secured to the cam-drum there is a block on which a roller *J* is mounted, and this roller engages a cam *K* on the agitating mechanism at each revolution of the drum. Cam *K* is secured to a rod *L* that extends through to the opposite side of the hopper, where a block *M* of quite similar form to cam *K*, is mounted on the rod.

When roller *J* oscillates cam *K*, pin *N* which projects through the hopper, so that its ends are secured to cam *K* and block *M*, causes the two agitating plungers *I* to rise and loosen any of the blanks which may have become stuck at the bottom of the hopper. Horizontal clearance slots are provided in cam *K* and block *M;* and vertical clearance slots are provided in the walls of the hopper, in order to give pin *N* the necessary freedom of movement; but attention is called to the fact that this pin is a tight fit in the two agitating plungers *I*, and its vertical movement is accomplished by the raising of cam *K*, and the transmission of this movement through rod *L* to block *M*. In this way the cam and block lift opposite ends of pin *N* and raise the agitators *I*.

Magazine for Holding Bolt Blanks

The William H. Ottemiller Co., of York, Pa., uses Cleveland 5/8-inch Model B automatic screw machines for the performance of a shaving operation on the heads of bolt blanks. As the blanks come to these machines, they have had the shank turned and the under side of the head has been faced, and these points are used for the double purpose of locating the blanks in the chuck and for guiding them through the feed-chute that is utilized for delivering the blanks to the chuck. One of the Cleveland automatics equipped with a magazine of this kind is illustrated in Fig. 2, and from this illustration it will be apparent that in the present instance the magazine is mounted at the rear of the cross-slide. The operation consists of shaving the bolt head to the desired form, and the magazine comprises a slotted member which receives the turned shanks of the bolt blanks, and a second slotted member which receives the heads. The blanks are introduced at the top and run down by gravity, without danger of blocking, so that in this case no agitating device is required.

Arrangement of Magazine on the Cross-slide

The magazine *A* is mounted at the rear of the cross-slide, and the formed shaving tool *B* is at the front of this slide, while the plunger *C* for pushing successive blanks from the magazine to the chuck is carried on the milling slide of the machine. The sequence of movements in feeding a blank to the chuck and performing the required operation on its head is as follows: Cams for actuating the cross-slide and

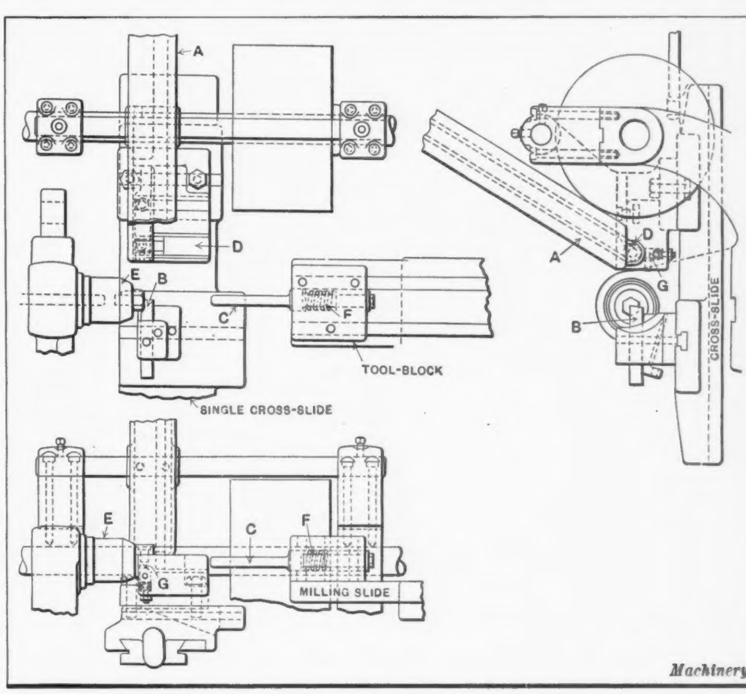


Fig. 5. Mechanism of the Feeding Magazine shown on the Machine in Fig. 2

the milling slide are so timed in relation to each other that the cross-slide first moves forward to bring the guide bushing *D*, in which a bolt blank rests at the base of the magazine, into line with chuck *E* carried by the spindle of the machine; then the milling slide cam moves this slide to the left, so that plunger *C* can push the bolt blank from bushing *D* into place in chuck *E*. Behind plunger *C* there is a spring compensator *F*, Fig. 5, that provides adjustment for any slight difference which exists between the length of successive bolt blanks.

From the end view, Fig. 5, it will be apparent that the head of the bolt blank rests in bushing *D*, and such being the case, it will be evident that provision must be made for supporting the blank at the shank end. Such provision is made by a small plunger *G* supported on a spring. The top of this plunger is concave to fit the bolt shank and it is beveled at the right-hand side, so that when plunger *C* pushes the bolt into the chuck, the square edge at the under side of the bolt head strikes the inclined face of plunger *G* and forces it down against the spring tension, to enable the bolt to enter the chuck. Then when plunger *C* is withdrawn, plunger *G* springs back into place and another bolt blank drops from the feed-chute into position for the next operation. After the milling slide has receded sufficiently so that plunger *C* is clear of the magazine, the cross-slide cams move this slide backward, so that shaving tool *B* that is mounted at the front of the slide comes into contact with the head of the bolt carried in chuck *E*, to perform the necessary shaving operation.

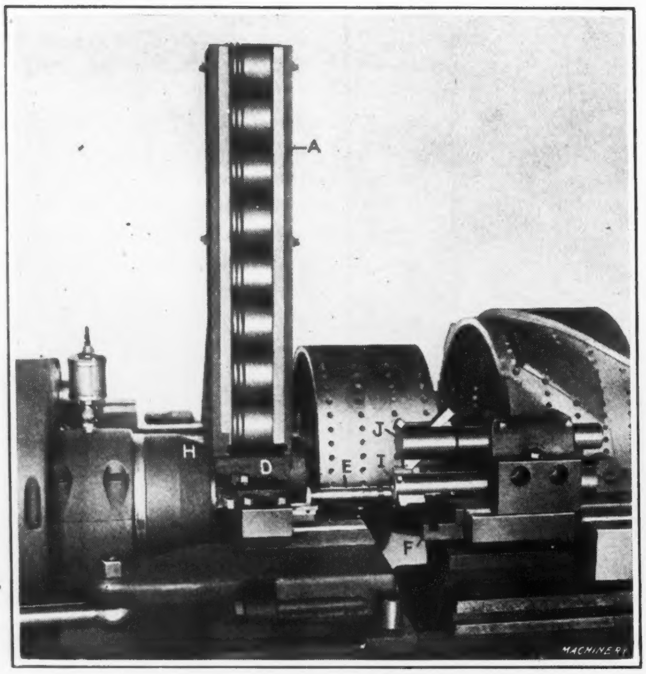


Fig. 6. Two- by Two and Three-fourth-inch Automatic Screw Machine equipped with a Feeding Magazine for delivering Pistons to the Chuck for performing a Boring and Facing Operation on the Skirt

Magazine Used for Boring and Facing Pistons

At the Northway Motor & Mfg. Co.'s plant in Detroit, Mich., Cleveland 2- by 2¾-inch Model B automatic screw machines shown in Fig. 6 are used for boring and facing pistons. The machines used for this purpose are of the double slide type, and the magazine rests on the rear cross-slide. As illustrated in the end view, Fig. 7, the magazine *A* is pivoted on the camshaft *B* and the force of gravity holds it down on a block *C* carried on the rear cross-slide in the manner previously described. At the front of block *C* there is a cradle *D* which holds one piston. When the rear cross-slide is drawn back, cradle *D* comes into place under the magazine so that one casting can drop into it; then, as the cross-slide is pushed forward, this casting is brought into line with the spindle of the machine, so that the piston may be pushed out of cradle *D* into the chuck. Meanwhile, the top surface of block *C* is under the magazine and holds the other castings until the cradle has been drawn back under the magazine.

When cradle *D* carries a piston forward into line with the spindle, a plunger *E* carried by the magazine moves forward so that a hook on the end of this plunger engages a slot in a bracket *F* carried at the front of the milling slide. To understand this arrangement, it will be best to refer to both Figs. 6 and 7. Timing of the cams that actuate the cross-slide and the milling slide is worked out in such a way that when a piston has been brought into line with the spindle, plunger *E* is engaged by hook *F* on the milling slide, and this slide advances so that plunger *E* will push forward a finger *G* that comes into contact with the piston and carries it into place between the jaws of chuck *H*. Plunger *E* is made in two sections, with a compression spring between them, which affords the necessary compensation for differences in the size of the casting, thus protecting the machine from damage in case there is any substantial variation. After the milling slide has moved back to its initial position, the cross-slide is withdrawn, thus carrying the magazine and plunger *E* out of the way, so that a Kelly reamer *I* and a combination boring and facing tool *J* can bore the inside of the piston and counterbore and face its open end, when the milling slide is again moved forward.

Magazine for Handling Fiber Disks

The American Vulcanized Fiber Co. of Wilmington, Del., makes various products in the manufacture of which

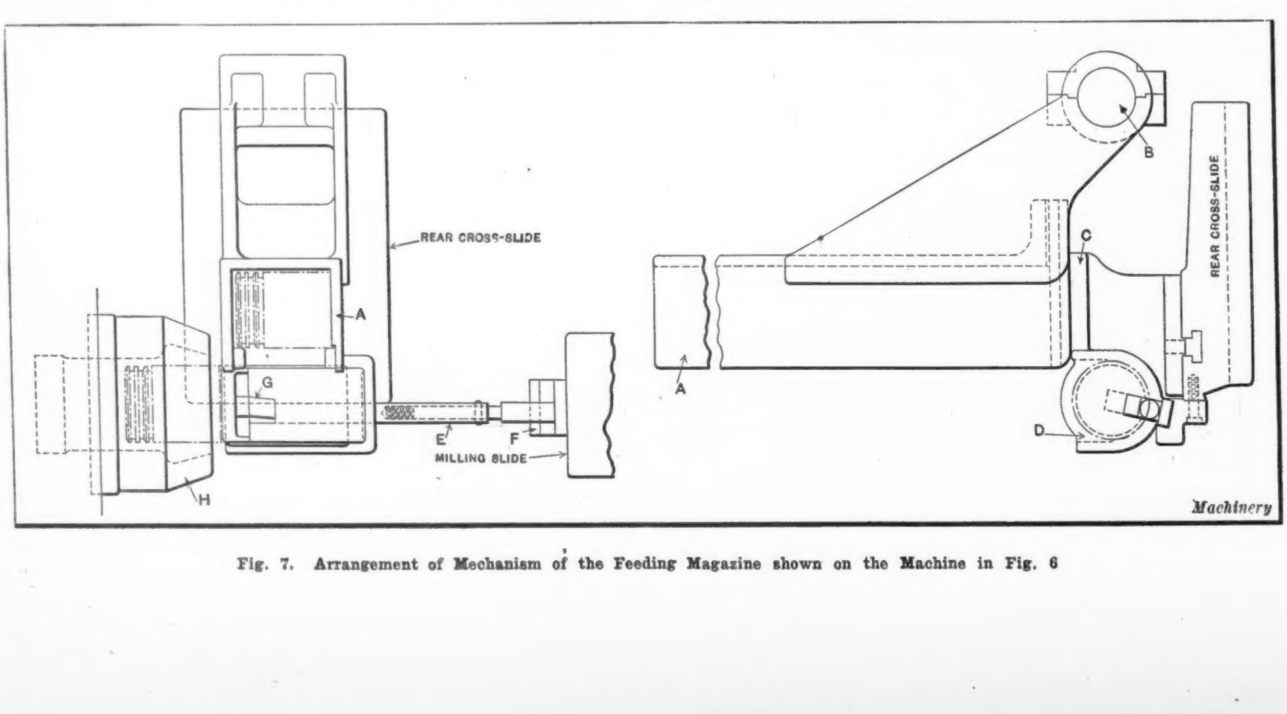


Fig. 7. Arrangement of Mechanism of the Feeding Magazine shown on the Machine in Fig. 6

it is required to stamp out washers and similar shaped pieces from sheet fiber. The small disks cut from the center holes in such parts are available for use in the making of other products, and in Fig. 9 there is shown the magazine feed mechanism used on a Cleveland 7/8-inch Model B automatic screw machine that is employed for the drilling of holes in these salvaged fiber disks. This magazine is mounted on the rear cross-slide of a double slide type of machine, and referring to the illustration it will be apparent that the magazine *A* is constructed from two pieces of angle-iron with retaining strips on the inside, as shown in the cross-sectional view; this construction provides for holding the disks in the magazine when they are dropped in edgewise.

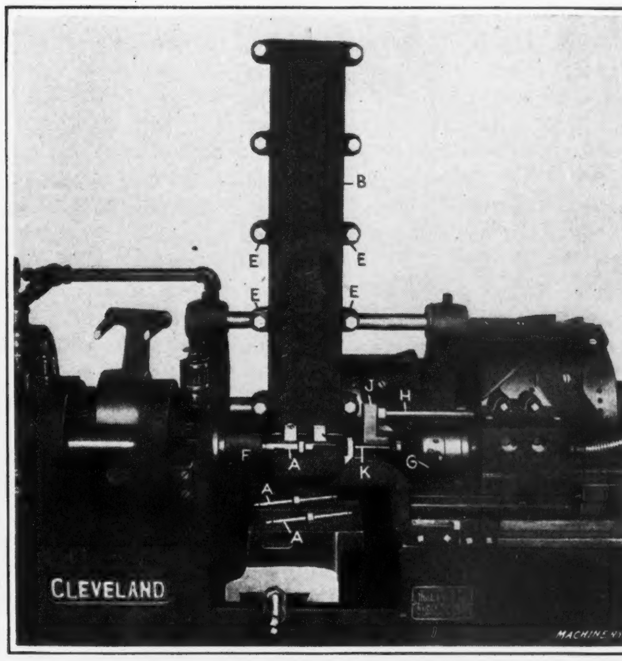


Fig. 8. Seven-eighth-inch Automatic Screw Machine equipped with Magazine for feeding Double-ended Screws to the Chuck in which they are held while performing the Threading Operation

The arrangement of the mechanism for transferring successive pieces of work from the magazine to the chuck is quite similar to that of the magazine shown in Figs. 6 and 7. The movement is derived from the milling slide, and as the cross-slide carries the magazine forward to bring a blank into line with the chuck, a hook on the end of plunger *B* carried by the magazine is engaged by a slot in the milling slide, so that when this slide moves forward, provision is made for advancing plunger *C* that pushes the blank into the chuck. Connection between plungers *B* and *C* is accomplished by a link *D*, and it will be seen that there is a spring compensating device at *E* to adjust for any differences in the thickness of the blanks. After a blank has been pushed into the chuck *F* and the milling slide has returned to its initial position, the cross-slide withdraws magazine *A* and plunger *B* back to their starting point, so that twist drill *G* may be moved forward by the milling slide to provide for drilling a hole in the disk which has been chucked for that purpose.

One of the most interesting features of this blank-feeding mechanism is the provision made for holding the bottom blank in magazine *A* in a vertical position while it is being pushed over into place in the chuck *F*. In the position which it occupies at the bottom of the magazine, the center of this blank is 1/16 inch above the spindle center; and at the left-hand side of the magazine, there is an opening cut through the side plate on an incline, as indicated at *H*. The bottom blank in the magazine is supported by a cradle *I;* and when plunger *C* moves to the left to push this blank into the chuck, the blank is pushed downward by the beveled edge of opening *H*, so that its center comes into line with the center of the spindle.

Cradle *I* is secured to a pivot *J* which also has a short lever *K* secured to it. At its lower end, this lever *K* bears against a plunger that moves back against a compression spring *L*. Hence, when plunger *C* pushes a blank to the left and this blank moves vertically downward, due to the beveled edge of opening *H*, cradle *I* moves downward against the pressure of spring *L*, and after the blank has entered the chuck and plunger *C* has been withdrawn, this spring returns cradle *I* to its initial position. After being drilled, the work is ejected from the chuck by a push-rod.

Magazine for Holding Double-ended Screw Blanks

At *A* in Figs. 8 and 10, there is shown a screw that has a head at the center and a threaded stem at each end. Screws

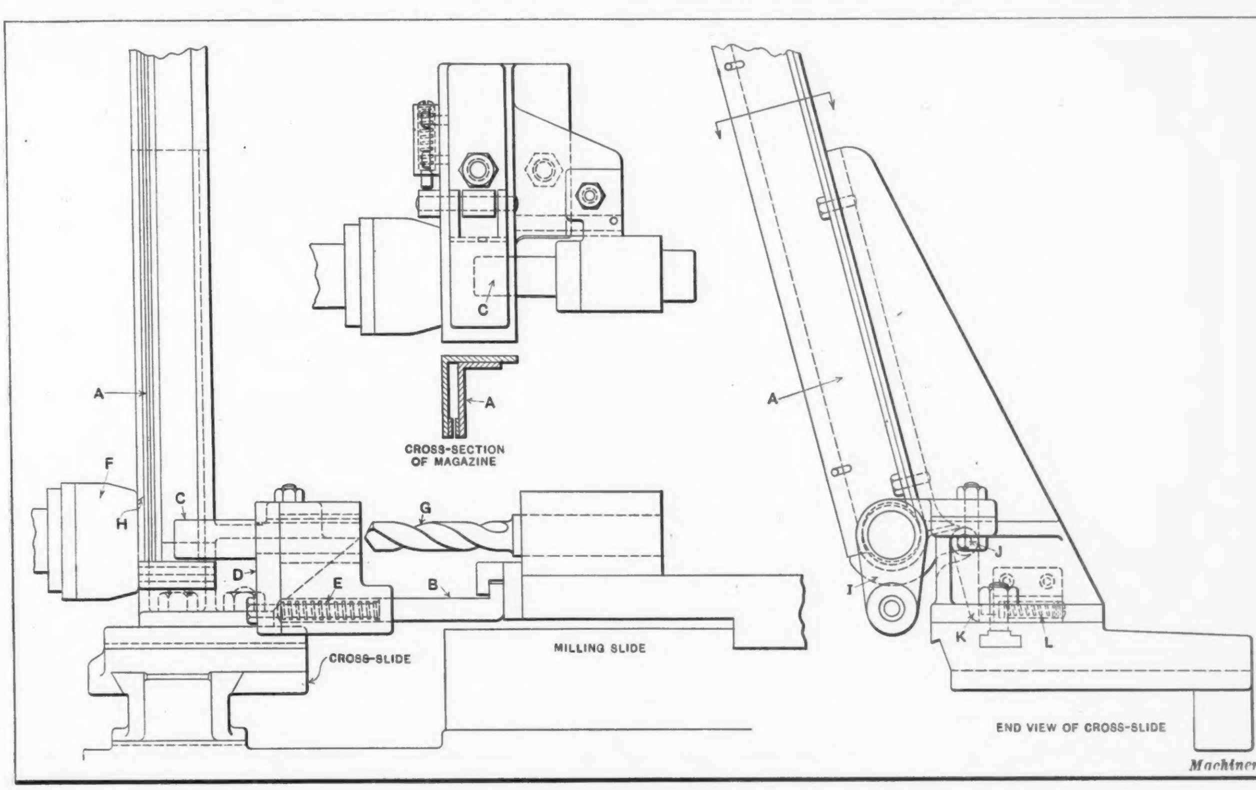


Fig. 9. Feeding Mechanism mounted on the Cross-slide of a Seven-eighth-inch Automatic Screw Machine used for drilling Holes in Fiber Disks

of this type are used for adjusting demountable rims for motor car wheels made by the Kelsey Wheel Co. of Detroit, Mich. Blanks for these screws are delivered to Cleveland 7/8-inch Model B automatics which are employed to cut a right-hand Acme thread at one end and a left-hand Acme thread at the opposite end of the work, two operations being required to complete this threading. It will be seen that magazine *B* is held on a horizontal rod *C* carried by special brackets *D* that are bolted to the tops of the bed arms that support the camshaft.

As in the case of the mechanism for handling Northway pistons illustrated in Figs. 6 and 7, there is a special transfer slide mounted at the rear of the cross-slide and arranged to carry successive blanks forward from the magazine *B* to a position in line with the center of the chuck. Referring to the plan and side elevation of the magazine in Fig. 10, it will be seen that it consists of two strips of metal having grooves planed to two depths down their inner sides, to form a channel that receives the enlarged portion at the center of the work and the stem at each side of the head. At the edges there are lugs *E* through which bolts are passed to hold the two members of the magazine together.

As each successive piece of work reaches the bottom of the magazine, it drops into a cradle and is then carried over into line with the chuck, so that a push-rod on the milling slide can transfer it from the cradle to enable chuck *F* to grip the work by the stem at its left-hand end. The arrangement of the plunger on the milling slide and of the transfer mechanism have been worked out along different lines from the arrangement shown in preceding illustrations. In the present case, it is required to use a die *G* to thread the work, and as this tool is rather bulky it was necessary to mount plunger *H* and the mechanism which it actuates so that it would clear the threading die.

On the transfer mechanism, there is a slide that moves against the tension of a compression spring *I*. This slide carries a projecting arm *J* which engages plunger *H* on the milling slide, when the transfer slide under the magazine has carried a blank forward into line with the chuck. After plunger *H* has come into engagement with arm *J*, this plunger moves the transfer slide over against the tension of spring *I*, and a plunger *K* carried by the slide engages the screw blank that has just been taken from the magazine and pushes it into place in chuck *F*. Spring *L* supports the thrust of plunger *H* and compensates for slight differences in the lengths of the screw blanks. The camming of the cross-slide which carries the main transfer mechanism and of the milling slide is so arranged that after the blank has been placed in the chuck, the milling slide recedes and the cross-slide withdraws the transfer mechanism back into its initial position under the magazine, thus disengaging plunger *H* from arm *J*. Then the milling slide is once more advanced to enable die *G* to cut the required thread on one end of the screw. The finished piece of work is ejected from the chuck by a push-rod *M*, which is actuated from the regular bar feed mechanism by means of positive cams.

As shown in the front view of the mechanism, at the lower left-hand corner of Fig. 10, two V-blocks *N* and *O* hold the screw blank by the ends of its shank. It will be seen that V-block *N* is made in the form of a plunger, supported by spring *P*, while V-block *O* is carried at one end of a pivoted horizontal arm, the opposite end of which engages a compression spring *Q*. When plunger *K* pushes screw blank *A* into chuck *F*, the inclined right-hand side of V-block *N* is engaged by plunger *K*, and the block is pushed downward against the tension of spring *P*. Similarly, the hexagon head at the center of the screw blank, engages the inclined side of V-block *O* and pushes it downward by swinging the horizontal arm about its pivot, against the tension of spring *Q*. When the milling slide is withdrawn, V-blocks *N* and *O* are returned to their initial positions by the action of springs *P* and *Q*. After the threading operation, die *G* recedes and the cross-slide carries another blank forward to repeat the cycle of operations.

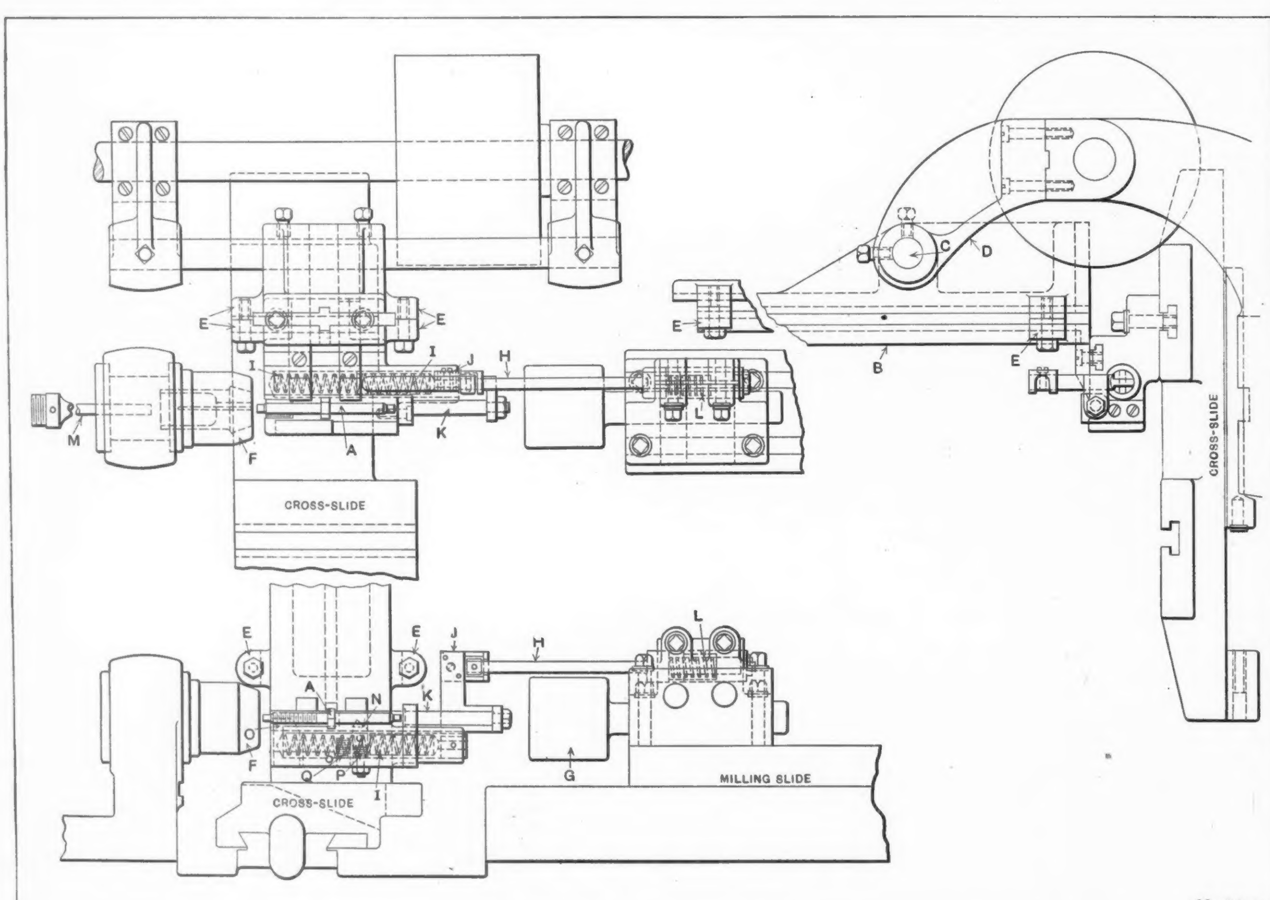


Fig. 10. Arrangement of Mechanism of the Feeding Magazine shown in Place on the Machine in Fig. 8

Common Causes of Errors in Machine Design

Frictional Losses—Unbalanced Parts—Manufacturing Operations—Assembly—Disassembly—Safety
Third of a Series of Articles

By R. H. McMINN

IN the first two installments of this series of articles, that were published in the January and February numbers of MACHINERY, several important factors that must be considered in machine design in order to prevent errors were discussed. The present article takes up additional points governing the design of a machine, such as frictional losses, provision for lubrication, balancing of parts, manufacturing considerations, assembly, erection, disassembly, and safety requirements.

Frictional Losses

It is not strange that loss of power due to friction in a machine is often overlooked by designers. In mechanical problems, the only definite relation between the force applied at one point in a mechanism and the resistance overcome at another point depends upon the relative distance moved by these points. The friction loss is a greatly varying quantity. In a large number of problems illustrating the laws of mechanics, students are told to ignore friction. The habit is thus acquired, and the geometrical relationships of a drawing do not suggest its consideration. However, there is a friction loss between any two surfaces having either sliding or rolling contact.

The loss in friction in a long train of mechanism including cast-tooth gearing may be 50 per cent or more. A machine having 50 per cent loss thus requires double the power to drive that a frictionless machine would need. The members through which the power is first applied must likewise resist a stress twice as great as in a frictionless machine, and must be increased correspondingly in strength. The efficiency of a single worm and gear may be as low as 50 per cent unless properly designed, machined, and lubricated. It should also be noted that the friction of starting is much higher than running friction, and must be given special consideration for any machine which must start under full load. There is likewise a friction loss in the movement of liquids or gases, such as water or air, in pipes.

Provision for Lubrication

The provision of methods of lubricating surfaces in contact between which there is relative motion and which require lubrication is sometimes overlooked by designers. Some shops do not insist that the location of oil-holes and oil-grooves be indicated on drawings of the parts that require them, but the shop men use their own judgment in this matter. This is bad practice for a number of reasons, but the principal one affecting the designer is that it may get him out of the habit of considering the necessity for lubrication. While the shop can provide means of lubrication in simple cases after the castings and other parts are made, the selection of a proper means of lubrication in some cases radically influences the design of a machine, as, for instance, where the splash method is used or gears run in oil. A designer should therefore always consider the means to be employed in lubricating all necessary parts as soon as possible during design.

Unbalanced Parts

All rapidly revolving elements like disks, wheels, pulleys, drums or cranks should be designed so that their center of gravity coincides with their axis of revolution. If the center of gravity is not so located, centrifugal action will produce a force, constantly changing in direction, acting upon the shaft and bearings of the revolving part, thereby producing additional stresses and vibration. Unbalanced weight in a rolling wheel causes variations in pressure on the track on which it rolls, and transmits shocks to the track.

If the center of gravity coincides with the axis of revolution, the part will have static balance, but it may not have balance while rotating unless it be a thin disk. The condition of running balance is met if the masses in each plane at right angles to the axis balance each other, so that the effect is the same as if a series of perfectly balanced thin disks were centered side by side on a shaft. If the design prevents this condition from being realized, as in a crankshaft, the crankpins and arms should be so spaced along the axis that the moment of force which the unbalanced mass in any plane imparts to the shaft during rotation is balanced by the moments of force which the other masses impart. There will then be no unbalanced pressure on the bearings due to centrifugal force, and hence no vibration from this source. Because of lack of homogeneity of metal or the inaccessibility of certain parts for finishing, each part needing to be balanced should also be balanced by trial after being made, by the removal or addition of metal at the required points.

Reciprocating masses, such as a piston and connecting-rod, also produce an unbalancing effect due to the variations, throughout their stroke, in the force necessary to accelerate them. A vibration is thus produced in the direction parallel to the center line of the engine cylinder. This effect may be altered by adding a weight to the engine crankshaft, so that the vibration in the original direction is eliminated, but there will then be a disturbing force acting at right angles to this direction; or, sufficient weight may be added to the crank so that the effect of vibration will be divided between the directions parallel and at right angles to the center line of the cylinder. Unbalanced reciprocating masses, however, can only be properly balanced by other reciprocating masses suitably arranged. The four-cylinder gas engine has cranks arranged to balance both rotating and reciprocating masses. For the most perfect balancing, the fact that

the piston does not have true harmonic motion must be taken into account.

Manufacturing Operations

The designer must constantly keep in mind while designing a machine all the manufacturing processes that must be employed in building it. He may be restricted in the size of casting which can be molded in the foundry where the castings must be made. This may require that a member be made in two parts instead of one. Long cast-iron cylinders are sometimes made in more than one piece, because of the limitations imposed by the equipment of a certain foundry on this class of work. The thickness of material in some parts may have to be made greater than dictated by strength alone, in order to cast the parts properly. The minimum thickness that may be cast without undue care depends to some extent on what class of work a foundry usually handles. This minimum thickness may be one-quarter inch, or as little as one-eighth inch, or even less, being partly dependent upon the material, size, and proportions of the casting.

The shape of certain parts and the manner of finishing them may necessitate their being cast or forged with special lugs or bosses for clamping, chucking, or centering, but which perform no function in the completed machine. Piston-rings of smaller sizes are cut from a cylinder having lugs or a flange on one end for chucking, a number of rings being cut from each cylinder. On some castings a piece may be cast on to prevent warping or to preserve rigidity while being machined, which is afterward sawed or machined off. In Fig. 5 is shown the expanding ring for a clutch, which is cast as a complete cylinder, the dotted portion being cut out after the rest of the machine work is completed.

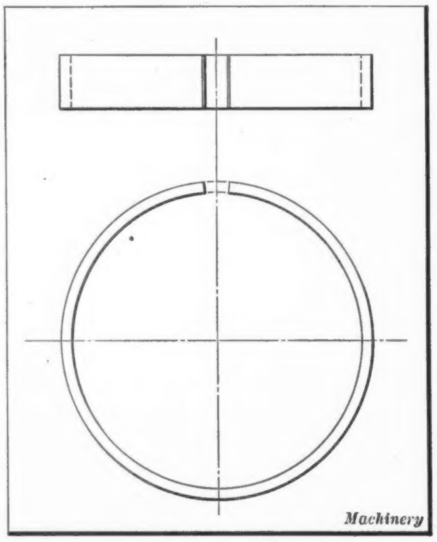


Fig. 5. Class of Work which is first cast as a Solid Continuous Ring and then cut after machining

The minimum size of bolt to use in any place may depend on the minimum diameter that can be satisfactorily cored through a certain thickness of metal. The thicker the metal and the higher its melting temperature, the larger the core that is required to prevent its being burned and thereby making an imperfect hole.

Limitations in size and form of parts which are forged, planed, turned, milled, ground, or finished by any other process must be given careful consideration during design. A limitation may be imposed upon the design of a part, not because it is impossible to make, but because the manufacturer has no machine of a proper size or type by which it may be finished. The bed of a new machine might be first designed with a bracket projecting on one side to support a motor. If it is noted that the largest planer possessed by the manufacturer by whom the casting must be planed is too narrow between the housings to handle this casting with the bracket cast on, probably a pad can be cast on the side to which a separate bracket can be bolted.

If it appears that the contemplated design of any part cannot be modified to meet the restrictions imposed by the manufacturer's equipment, the part can possibly be made elsewhere. If the designer develops a part which has a form apparently essential, and yet does not know from his own experience definite and reasonable methods by which it can be made, he should make no assumptions in the matter, but should take the question up with the manufacturing department.

Method of Assembling—Erection

Assembly is sometimes considered as the collecting of single parts into logical groups, such as the headstock, tailstock, or carriage of a lathe; and erection is taken to mean the assembly of all such groups on a frame or bed to form a complete machine. Assembly will here be treated as the combining of either single parts into groups or groups into a machine, and the term erection will be considered as referring to the assembly of a machine or structure in its final location.

Unless attention is given to how the parts of a machine are to be assembled, serious difficulties may arise. There must not only be proper clearance for all parts of a machine after they are arranged in their intended location, but there must also be sufficient clearance to get them in this location. This clearance should exist not only at one time during assembly but if possible at a logical time. If a small part like a bolt must be put in its place long before the part which it supports, the assembler may overlook placing it at the proper time. If it is a heavy part that must be put in the interior of a machine long before there is anything there to support it, this may interfere with the ready assembly of other parts. When a part is subject to wear, it should be noted that if it requires early assembly to get into place it will probably be difficult to remove and replace it when this becomes necessary.

Small parts are sometimes made so that they must be turned in a special manner in order to obtain sufficient clearance to move them to their intended position during assembly. It is well to avoid the necessity for manipulating a heavy part in a peculiar manner to get it into position. If a part is so heavy that it has to be handled by a crane or other mechanical lifting means during assembly, one should consider whether its shape will permit a hook or chain sling to be attached readily and securely. If not, special holes, lugs, or loops should be provided. Some motors have one or more lifting eyes on the top of the frame. Manholes must often be provided so as to make the inside of a hollow member, such as a boiler, accessible for assembly and other purposes. Hand-holes must be provided in the web of a box-girder (which is hollow) in order to put bolts in any part which must be bolted to the outside of the web after completion of the girder. Sufficient room must be allowed for the application and manipulation of wrenches in tightening all nuts on the machine.

If a machine or structure is being designed especially for a certain purchaser, consideration should be given to whether there may be any modification in design required to insure the easiest erection in its final location. It is difficult to say what the limitations should be on the weight of any single part in relation to the ability to erect it, since the capacity of equipment for handling heavy weights keeps pace with the constantly increasing sizes of machines in general. It is probable that any shipping unit which does not exceed the limits in weight imposed by transportation by rail can be erected by available means.

The portable equipment used by one large Chicago erecting company for its heaviest work has a capacity of 125 tons through a lift of about fifty feet. It consists of two uprights with a cross-member at the top to which the upper rope block is attached, and a winch that can be manually or motor operated. Such rigs are called shear-legs. If the purchase price of a machine includes erection by the manufacturer, the latter should know prior to taking the order whether there is a crane of sufficient capacity serving the space where the machine must be erected, or whether he will have to go to the expense of transporting and returning special erecting equipment.

It would not be economical to request that a manufacturer modify the design of some classes of standardized machines like lathes or drilling machines to suit a space of a certain size or shape in which a concern wished to use a machine of this kind; but other classes such as cranes, conveying machinery, air-hoists, elevators, foundry cupolas, and core ovens are constantly modified to suit the requirements of a particular location. If a furnace or machine is being erected in a position where there will be small clearance between the ceiling or the walls and the machine, special attention must be given to seeing that all parts can be placed in their proper position before that position is made inaccessible to an erector by lack of clearance. If possible to avoid, no member likely to need replacement should be placed where there is so little clearance that its removal will require a radical dismantling of the machine. It should also be noted that the amount of overhead clearance may affect the permissible methods of erecting a machine and therefore, possibly, its design.

Likewise, if it be required to erect any equipment such as an elevator and guides in an enclosure like a brick well, no vertical member must be so long that it cannot enter the opening in the well and be brought to position. It is evident that a knowledge of erecting conditions is necessary in order to be sure to meet erecting requirements.

Designing for Safety

A machine should be made as safe as possible for the operator or any others who may come in proximity to it. Safety requirements should be anticipated by the manufacturer when possible instead of having a state factory inspector demand the addition of safeguards. Sometimes designs are submitted to the state inspection department before a machine is built. Projecting revolving parts are dangerous because the clothes of the operator may be caught on them. Any parts to which the operator is exposed which have a variable clearance between them, as between a punch and die during operation, may be a source of danger, and if so should be guarded, if it is in reason to accomplish this. All gears on power-driven machines by whose teeth an operator or anyone coming close to a machine might be caught should be covered, at least on the periphery, and preferably all over.

The possibility of accidentally starting a machine by a hand, foot, or weight of the body when another member is in a dangerous position should be guarded against if possible. Protection should be provided against the operator's slipping, falling and grasping a moving part, and having his hand drawn between two parts, such as a belt and pulley or chain and sprocket. An analysis of what would happen if any part of a machine were to become loose or be broken would suggest the necessity for other safety devices.

Provisions for Disassembly

Attention should be given to the disassembly of some parts of a machine which may be difficult to remove because of the method by which they are fastened to or associated with other parts. It is legitimate to rivet together the structural parts forming a crane girder, or to weld parts forming one-half of a gear-case, because the units composing the larger parts will not, as far as can be foreseen, have to be removed singly. However, when a part may have to be separated from another in the future for any reason, the two should not be welded or riveted together.

If the head of a bolt is not accessible during the tightening of the nut it is a good plan to have at least one side of the bolt head come against a shoulder. This is a convenience in the original tightening, but is particularly valuable if the threads become somewhat rusty after use, since it keeps the bolt from turning when attempting to loosen the nut. A plain countersunk-head bolt cannot be held in this manner. Unless the head can be held with a chisel, the nut may have to be cut off to remove it.

Frequently a gear is mounted on a shaft with its hub running against a solid bearing, and sometimes the gear must be removed from the shaft before the latter can be slid out of the bearing. If a taper key is used in the gear, the key must have a gib head in order to pull it from the hub, as the attempt to force the gear off the shaft will tighten it on the key. If a bushing is driven into a hole which has a solid bottom, special means are often provided to assist in removing the bushing from the hole. A projecting shoulder around the top of the bushing is best, if permissible. Sometimes small holes are provided beneath the bottom of the bushing, so it may be driven out, as at *A* in the expanding ring clutch shell shown in Fig. 6. Other times tapped holes are provided around the outside edge of the bushing into which small screws may be inserted to pull the bushing out as at *B*. Unless thought is given to how the parts of a machine can be disassembled, a difficulty may arise at a most unexpected place.

The fourth installment of this series, which will appear in the April number of MACHINERY, will treat of the following points to which a designer should give attention: Manufacturing cost; transportation of machines; and compactness and appearance of machines.

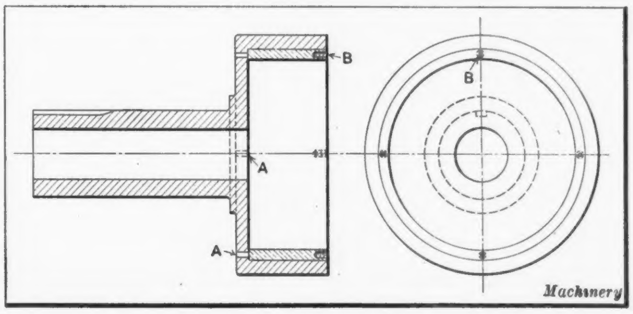


Fig. 6. Design showing Provision for Removal of Bushing

* * *

A valuable addition to the regular courses has been made at the Sheffield Scientific School of Mechanical Engineering at Yale University; the new course, initiated this year as part of the four-year curriculum in the engineering school, is intended to familiarize the student with engineering as a profession, the object being to give him a comprehensive perspective of the work for which he is fitting himself. The course explains in detail the character of the work in which civil, electrical, mechanical, and mining engineers may expect to engage, and serves the purpose of showing the student that the subjects contained in the prescribed engineering course are basic and essential to his development and success as an engineer, and of immediate use to him in the more advanced courses that he is later to pursue. This is a commendable departure in engineering education. In the past, all education has been based on the general principle that the student should accept what he is taught, and study without question the course selected for him. By giving the student a comprehensive view of the whole course at the beginning and showing him the interrelation of the different subjects to the actual work that he will perform later in the industrial and commercial activities for which he is fitting himself, his interest will be enlisted and he will also be better able to grasp the requirements of an engineer in practice.

* * *

The scarcity of coal in Europe has added interest to the development of the coal resources at Spitzbergen. Swedish and Norwegian companies are interested in coal mining in these northern islands, and while the output as yet is comparatively small, it is expected that from the mines worked by the Swedish company alone, 72,000 tons will be shipped during the present year. If no new coal resources are discovered in Europe, it will be necessary for Europe to obtain from the United States a large portion of its coal supply.

Dies for Electrical Terminals and Connectors

By JOHN A. HONEGGER

THE dies shown in the accompanying illustrations are employed in the manufacture of connectors or terminals for the wires of electric lighting units. The follow-die in Fig. 2 is employed in the production of terminals, one of which is shown completed at *B*, Fig. 1, and at *A* as produced by the die mentioned. The stock used in making this terminal is soft strip brass, 0.035 inch thick and 3/8 inch wide. The operations are piercing, blanking, and forming, and are performed in an inclined press. The stock is fed in from the right until it strikes stop-pin *B*. On the downward stroke, piercing punch *C* pierces the 0.374-inch hole, punch *D* trims the rounded end and severs the blank from the strip, after which forming punch *E* forms the terminal to the shape shown at *A*, Fig. 1.

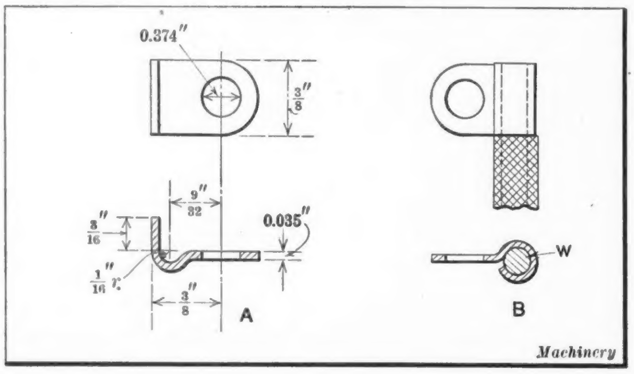


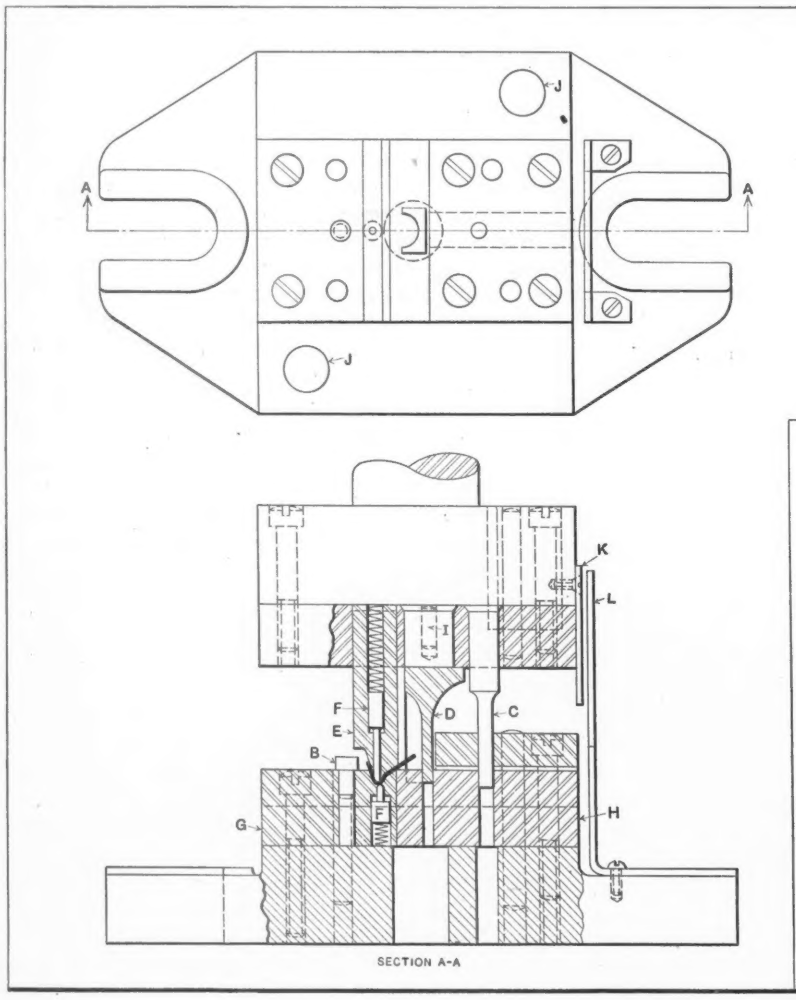
Fig. 1. Work produced by Dies shown in Figs. 2 and 3

On the return stroke, pin *F* ejects the work from both punch and die, and the part slides out at the back of the press. The die is made in two parts in order to facilitate grinding the piercing and blanking part *H* without destroying the shape of the forming portion of part *G*. The blanking punch is kept from turning by means of pin *I*, while the punch and die are kept in alignment by guide pins *J*. Sheet-steel guards *K* and *L* are fastened to the feeding side of the die to protect the operator against injury when feeding the stock to the die.

The second operation, that of curling and clinching piece *A*, Fig. 1, over the wire as shown at *B*, is performed by the die shown in Fig. 3, which is mounted on a foot-press. A terminal is placed over pin *B*, after which a wire *W* is put in the terminal, where it is located endwise by stop *C*. On the downward stroke, the upright portion of the terminal follows the outline of punch *D* and is therefore curled over and clinched as at *B*, Fig. 1. Two terminals are clinched on each wire.

Piercing, Trimming, and Forming Die for Connector

In Fig. 5 is shown the first of a series of three dies used in the production of the finished connector shown in the



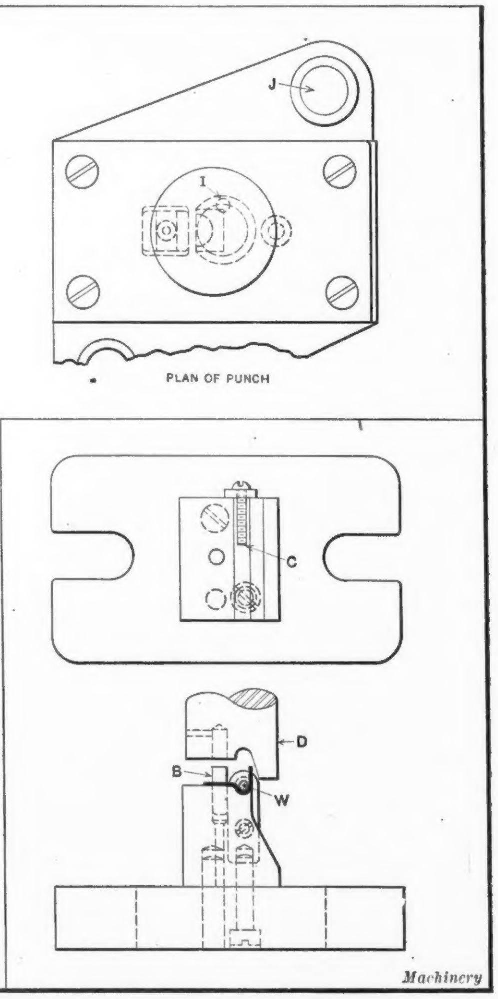


Fig. 2. Piercing, Cutting-off, and Forming Die for Work shown in Fig. 1

Fig. 3. Curling and Clinching Die

upper right-hand corner of Fig. 6. The stock is 0.032- by 13/16-inch soft strip brass. The operations performed by the die shown in Fig. 5 produce the part as shown in the upper right-hand corner of this illustration. The die pierces the 3/32-inch hole, cuts the two 1/16- by 9/16-inch slots, trims the end of the blank, severs the part from the strip, and forms it to the shape shown. The operations are performed in an inclined press, the stock being fed from the right until it strikes stop *D*. On the downward stroke, punch *E* pierces the 3/32-inch hole and the two 1/16- by 9/16-inch slots, which are blanked out when the end is trimmed. Punch *F* severs the stock and trims the end, after which punch *G* forms the connector to the shape shown in the enlarged view. On the ascending stroke, knock-out *H* ejects the part from the die. Should the parts stick to the punch, the tongue on gage *D*, acting as a stripper, will remove the piece so that it will slide out at the back of the press. The punches are kept in their proper positions by pins *J*, while the punch and die are kept in alignment by guide pins *K*. Sheet-steel guards *R* and *S* are placed on the feeding side of the die.

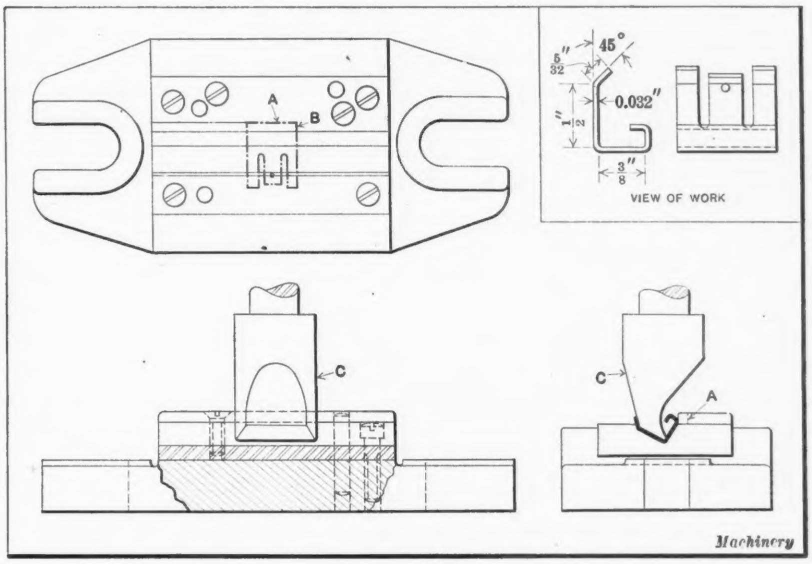


Fig. 4. Die for Second Forming Operation on Connector

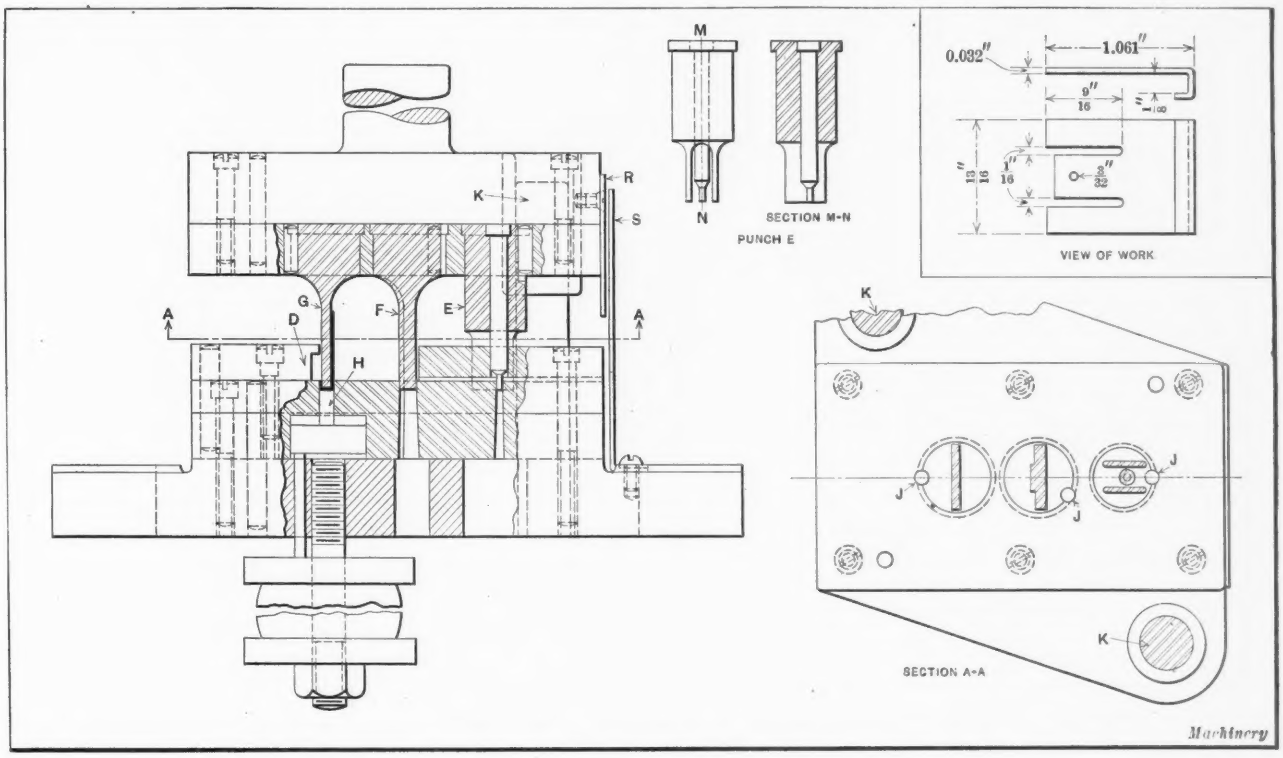


Fig. 5. Die for piercing, cutting off and forming Connector shown completed in Fig. 6

In Fig. 4 is shown the die used for the second forming operation on the connector. This operation is performed in a foot press. The double-bend portion of the blank is placed in recess *A* and against edge *B* as indicated by the dot-and-dash lines. Punch *C* forms a blank to the shape shown in the enlarged view. In Fig. 6 is shown the die that performs the third and final operation on the connector. This die is

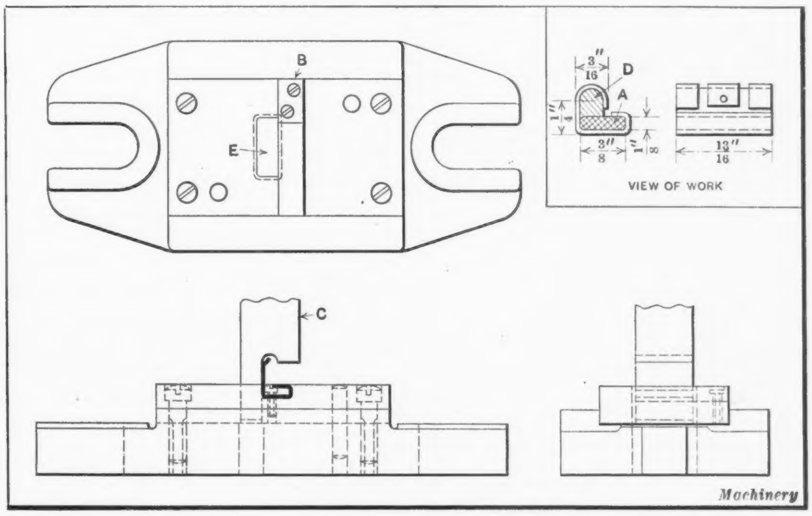


Fig. 6. Die for curling and clamping Connectors

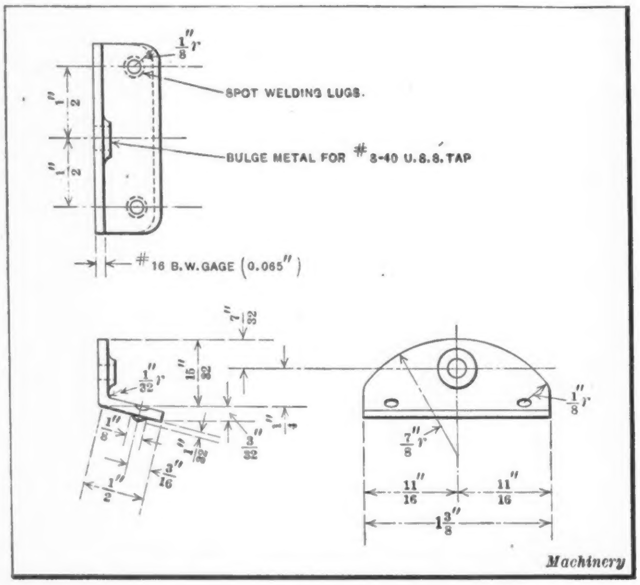


Fig. 7. Band Clamp End made from Cold-rolled Steel

also mounted on a foot press. A rectangular piece of conductive material *A*, as shown in the enlarged view, is inserted in the oblong space, and the blank is then set into the recess *E*, against stop *B*. Another piece of conductive material *D* is placed in the upper part of the connector after which punch *C* curls the end of the connector over piece *D*.

Dies for Making Band Clamp Ends

The first of a series of three dies for producing the band clamp end shown in Fig. 7 is illustrated in Fig. 8. The stock used for these clamps is 0.065 inch thick medium hard cold-rolled strip steel 1⅜ inches wide. The die embosses two spot-welding lugs; pierces a hole; trims the front end; severs the blank from the strip; and curls up metal for the boss. The operation is performed in an inclined press, the stock being fed in from the right until it strikes the first finger-stop *B*. Punches *C* emboss the two spot-welding lugs; punch *D* pierces the hole; and punch *E* partially trims the front end. After these operations have been performed, stop *B* is released, and the second finger-stop *F* is pushed in; the stock is then fed forward until it strikes stop *F*. Punches *C*, *D*, and *E*, then perform the same operations on the second blank. Stop *F* is next released, and the stock fed forward again until it strikes against stop *G*. The front end of the blank is then completely trimmed and severed from the strip by punch *H*, the piece being pushed down into die *K* until it is forced over the spreading punch *L*. Spring-actuated pilot *M* locates the blank so that the hole is kept central over the spreading punch *L*, and at the same time insures the accurate cutting off of the blanks. On the ascending stroke, knock-out *N* forces the blank from die *K*, while the ejector *O* forces the blank from punch *H* should it become stuck in the upper member. The blank slides out at the back of the press. This die is also furnished with sheet-steel guards as shown.

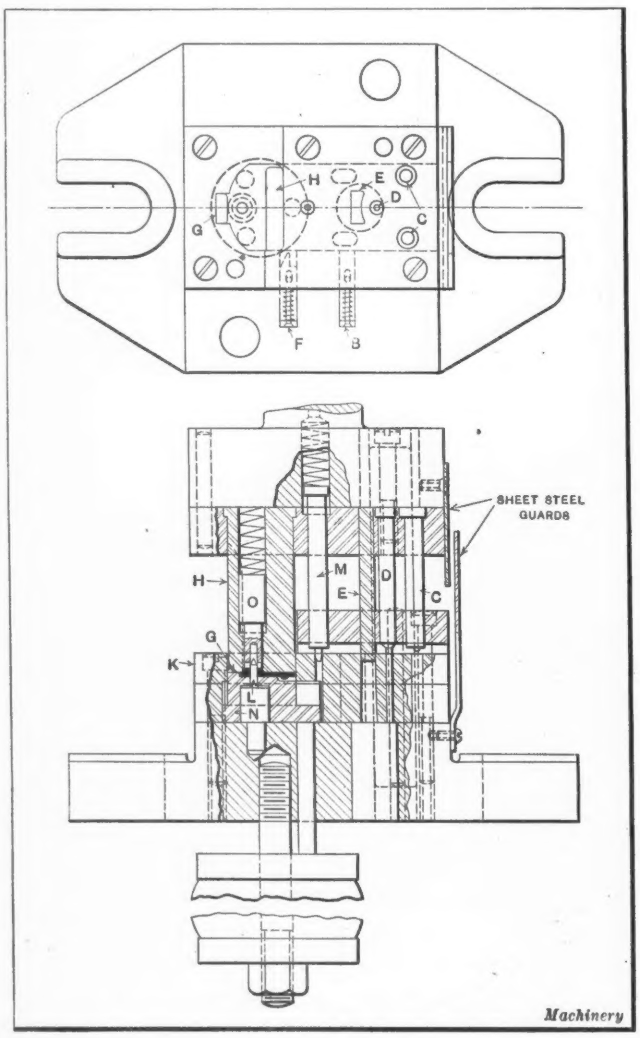


Fig. 8. Embossing, Piercing and Severing Die

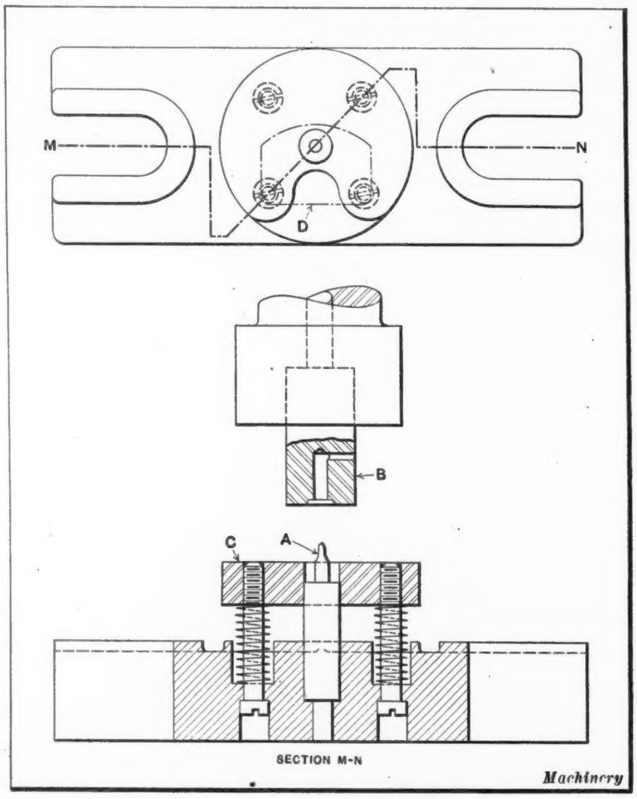


Fig. 9. Die for sizing Hole and swaging Boss

In the illustration Fig. 9 is shown the die that is used for performing the second operation on the band clamp. This operation is performed in a straight-back power press. The blank is placed over pin *A*, and as the ram descends, punch *B* forces the blank over pin *A*, thus accurately sizing the hole. The boss is swaged to shape against the shoulder on this pin and the formed recess in punch *B*. Stripper *C* strips the blank from pin *A* on the ascending stroke of the ram. It will be noticed that the stripper is cut away at *D* to facilitate removing the piece.

In Fig. 10 is shown the die employed for the third operation on the band clamp, which is performed in a foot press. The blank is placed in the recess of gage *A*, and on the descending stroke punch *B* bends the clamp to the shape shown at *E*. The die is relieved at *C* to form a clearance for the spot-welding lugs, while the punch is relieved at *D*

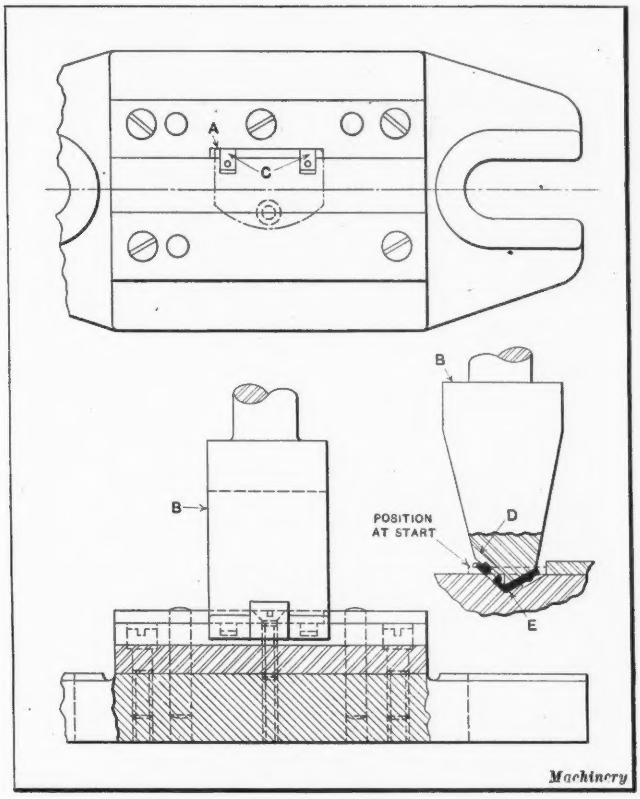


Fig. 10. Die for making Bend in Band Clamp End

in order to clear the boss. The working end of the punch presents a continuous surface, so that no irregularities or nicks are noticeable in the apex of the bend when the blank is formed.

* * *

ACETYLENE-DRIVEN AUTOMOBILES

Experiments were made with acetylene for driving automobiles in Switzerland several years ago, but the trials do not appear to have been satisfactory under normal conditions, according to an article recently published in *Engineering*, as when Zurich was visited in the autumn of 1919, not one acetylene-driven automobile could be found. However, Professor F. Haber, at the request of the German Government, has been experimenting with acetylene for driving a four-horsepower stationary motor and a twenty-horsepower Fiat automobile. He has found that it is difficult to get the maximum power with pure acetylene, because a third of the air is not really required for the combustion, so that it is dragged as ballast through the engine, and, therefore, the admixture of some other fuel is advisable. The fuel is then less ready to ignite, so that preignition is eliminated and, in addition, the fuel gives more heat per unit of time. By using a throttle mixer, the quantity of fuel mixture is varied, while the percentage of acetylene is kept constant. Since the adoption of this device, the automobile used in the experiments has run well on acetylene fuel.

* * *

HUGE BRONZE CASTING IN CHINA

In a recent lecture on the industry and progress of China, given by John R. Freeman, past-president of the American Society of Mechanical Engineers, and now connected with the Massachusetts Institute of Technology, mention was made of a mammoth hollow bronze statue 40 feet high and 20 feet wide which stands in a small town in the southern part of China. A casting of this size is believed to be beyond the capacity of any foundry today. The exact method followed in pouring it is unknown, but it is thought that the mold was built up in sections on the actual site of the statue, each section being added as the pouring progressed.

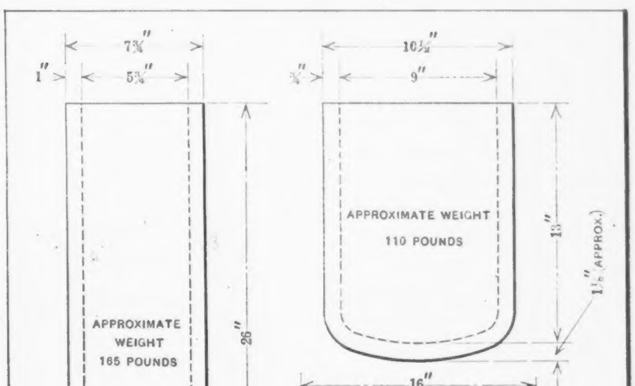
MANUFACTURE OF SEAMLESS STEEL TEMPERING POTS

To secure the required tempers in the manufacture of drills, saws, files, cutters, and other tools and fine mechanical parts, it is often necessary to bring the steel to the required temperature in molten lead, previous to immersion in the quenching fluids. The lead is usually contained in strong metallic cups known as tempering pots. These are generally made of open-hearth steel by a process of hot-punching and drawing, or by employing hydraulic machines especially designed for such work. Tempering pots made of cast iron or cast steel are not used where uniform results are the absolute requirement or where the workman's safety is fully considered. Pots made of wrought steel have supplanted the older types of pots because of the efficiency, economy, and safety which they represent.

In manufacturing a "Shelby" seamless steel tempering pot, a flat plate of open-hearth steel is trimmed to the shape of a disk and put in a furnace, where it is raised to a suitable temperature for pressing. At the proper heat it is withdrawn and placed in a heavy hydraulic press where a plunger, working in connection with a die, punches or forms the flat plate into the shape of a rough shallow cup. In this operation, the walls of the cup are left in a thick, somewhat irregular condition, and the bottom is not smoothly rounded at the corners.

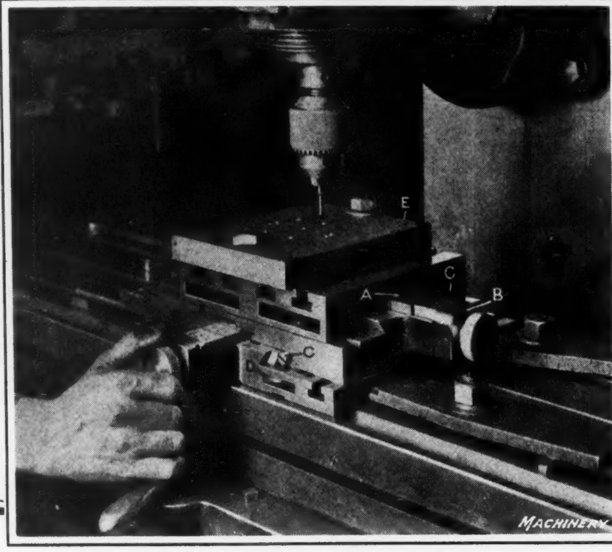
To correct these features and to give the cup or pot its proper length, shape, and wall thickness, it is reheated, and when at suitable temperature it is pushed through another die, which gives the dimensions and finish required. The volume of metal, size of plungers, dies, etc., are so calculated as to give a slightly greater wall thickness at the bottom of the cup where the heaviest duty is required than at other points of the wall. The dimensions of three seamless steel tempering pots, as regularly manufactured by the National Tube Co., Pittsburg, Pa., are shown in the illustration.

Seamless steel tempering pots, being made of homogeneous steel plates and formed under tremendous hydraulic pressure, are free from the blow-holes or sand defects sometimes found in castings. The service, therefore, is not only longer but more efficient than that given by pots of non-uniform material. The walls, being of uniform thickness and relatively thin for the strength involved, permit uniform distribution and quick transmission of heat to the substance placed in the pots. These pots are strong, yet relatively light, due to minimum cross-sectional wall area which is permissible because of the physical properties of the steel used.



Approximate Proportions of Commercially Manufactured Tempering Pots for Lead Furnaces

Using Compound Slide in Jig and Die Making



How the Johansson Compound Slide is Used in Tool-room Work, Especially in the Laying out of Accurately Spaced Holes

IN locating holes in master plates, dies, and jigs, there are various ways of doing the work, prominent among which is the familiar button method. The button method, however, which, when accurately applied, will produce the desired results, is at best slow and susceptible of cumulative errors. In addition, for work of this kind, the toolmaker must be a man of experiênce and should possess something more than mere toolmaking skill, for he must be patient and extremely careful; otherwise, the likelihood of error is great and the results correspondingly costly. The button method, therefore, has been to a large degree supplemented by the gage-block method of spacing holes. This method is recognized as both accurate and rapid. By the gage-block method is meant the practice of using parallels carefully adjusted at right angles on the faceplate of a lathe or machine table to locate the work from a previously finished side, and building up by means of standard gage-blocks.

This procedure is a somewhat awkward one, for it is necessary to unclamp and clamp the work with each shift of position; and this fact probably accounts for the size-block method not being generally adopted. But this method was the forerunner of a device for using gage-blocks in conjunction with two accurately machined slides, located at 90 degrees to each other, the combination of these two slides being known as a compound slide.

Construction of the Johansson Compound Slide

The compound slide, made by C. E. Johansson, Inc., Poughkeepsie, N. Y., is a ruggedly constructed precision tool, having a substantial base, which may be attached conveniently to the machine table or faceplate of a lathe and which supports two accurately machined slides. These slides are each operated by a knurled adjusting screw for sliding them on the dovetail slides of their respective supporting members. The construction may be seen in the heading illustration, which shows the slides positioned by means of suitable stacks of gage-blocks located between hardened steel buttons *A* and suitable rest pads *B* against which the slides are drawn by the operating screws. When in use, the position of the work is held fixed by locking the slides by means of screws *C*.

T-slots and clamping bolts are employed for clamping work to the top slide. In the base of the tool are gashes such as shown at *D* for convenience in securing the base to the machine. Each slide has a range of 3½ inches. The top plane is 7½ inches square, and the distance from its top surface to the under surface of the base is 3½ inches. The weight of the fixture is 55 pounds.

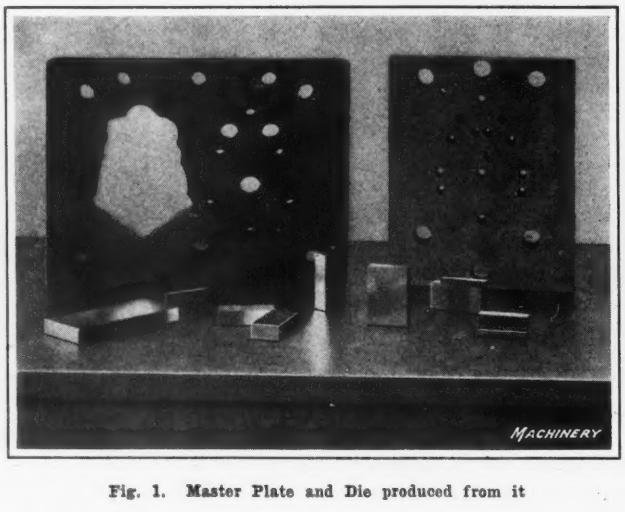


Fig. 1. Master Plate and Die produced from it

Uses of the Slide

In cases where the holes bear a certain relation to a finished side of the work, the button method must, of course, be resorted to in locating the first hole; but in the majority of cases this is not the condition, for the holes are usually spaced in accurate relation to each other rather than from a finished side. When it is necessary to locate the first hole from a finished side, the hole is laid out, drilled, and the button attached, as shown in Fig. 2; the button is then indicated preparatory to boring the hole to size. In this illustration, the slide is shown mounted on the table of a Van Norman duplex milling machine with the work secured to the upper slide and a "Last Word" indicator, made by H. A. Lowe, Cleveland, Ohio, carried in the drill chuck, as when truing up the button.

After this has been done, gage-blocks are laid in between the pad and button on each slide, and the position is secured by means of the previously mentioned locking screws. All other holes in the work can then be located directly and without the further use of cut-and-try methods. The location of the remaining holes in the work is accomplished by simply changing the over-all dimension of the stacks of blocks so that the slides may be located against them and locked in their new positions.

Frequently, the location of holes is indicated on the drawing by the use of dimensions and angles, in which case a simple trigonometric calculation must be made to determine the movements necessary to bring the work to the desired location. In Fig. 3 a Van Norman milling machine is shown equipped with a Marvin & Casler offset boring head and a twin-screw drill chuck for holding the single-point boring tool used in finishing the drilled hole, by means of which the button was formerly attached. Another application of the compound slide is shown in Fig. 4, with the tool clamped to the faceplate of a lathe. The possibilities of the tool for accurately locating work which is to be drilled or

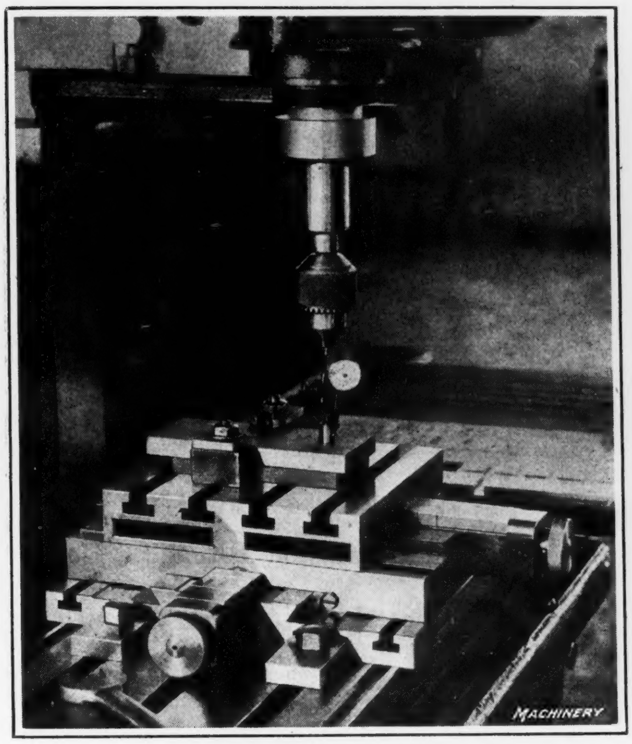


Fig. 2. Using Indicator for truing up a Button before boring the First Hole

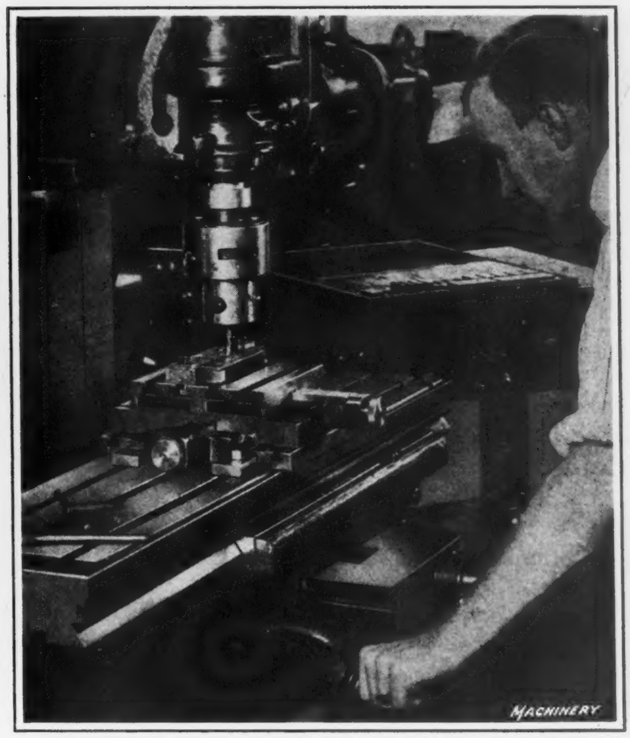


Fig. 3. Boring Holes on a Vertical Milling Machine, using the Compound Slide

bored with the aid of the lathe tailstock should be apparent, in view of the preceding description of its use on a vertical machine. In cases where a milling machine is not available for use, or in shops where work of this kind is regularly done in a lathe, the same degree of precision can be realized as in the case of the milling machine. The only precaution that should be taken in this connection is to see that the faceplate is of sufficient diameter to accommodate the slide so that it will not interfere in its rotation with the clearance space between it and the ways of the lathe.

Master plate work in the making of jigs, fixtures, and dies is usually conceived of as a class of work that must be performed by high-priced and skilled toolmakers. Without the use of fool-proof means for obtaining the accurate location of the work relative to the tool, this is true, but with the Johansson compound slide an economy in labor can be effected. Any ordinary mechanic can produce work with a much higher degree of accuracy and in less time by the use of the slide than a skilled toolmaker could under any of the commonly used locating methods. There is eliminated by the use of this tool the possibility of misreading graduations, the likelihood of errors resulting from play in the lead-screw, or the development of lost motion from other causes.

It is evident that in cases where the holes can be drilled without regard to their location from the finished surfaces of the work, all that is necessary is to establish approximately the location of the first hole, bore it, and then proceed directly to adjust the slides to correspond with the dimensions on the drawings. There are cases where the use of the button method is not feasible owing to lack of space or other conditions peculiar to the design of the work, and in such work the compound slide is invaluable.

Making Master Plates for Dies

The heading illustration and Fig. 1 show, respectively, the use of the slide and the appearance of the work produced on it in the plant of the Star Tool & Mfg. Co., Chicago, Ill. The heading illustration shows the slide set up on a Kempsmith universal milling machine with a master plate *E* attached to the top slide, and the boring tool used in machining the holes. This master plate was used in making a die employed in the manufacture of a lubricating pump of this company's manufacture. The master plate is used to locate all the holes, and irregular openings in the work. In Fig. 1 there is shown at the right a master plate, and at the left a die made from it. The time required to make the master plate, including locating, drilling, and boring the holes was six hours, and it is stated that the holes were located to within limits of plus and minus 0.0001 inch. It is believed that this degree of accuracy could not have been maintained if the compound slide had not been used, and also that it would have taken about twenty hours to have performed the work even with a less degree of accuracy. In this case, a machinist not only performed the usual high-grade work of laying out the holes, which ordinarily would have been done by a first-class toolmaker, but he also drilled the holes in the work all at one setting, thereby resulting in a considerable saving both in time consumed and in wages per hour.

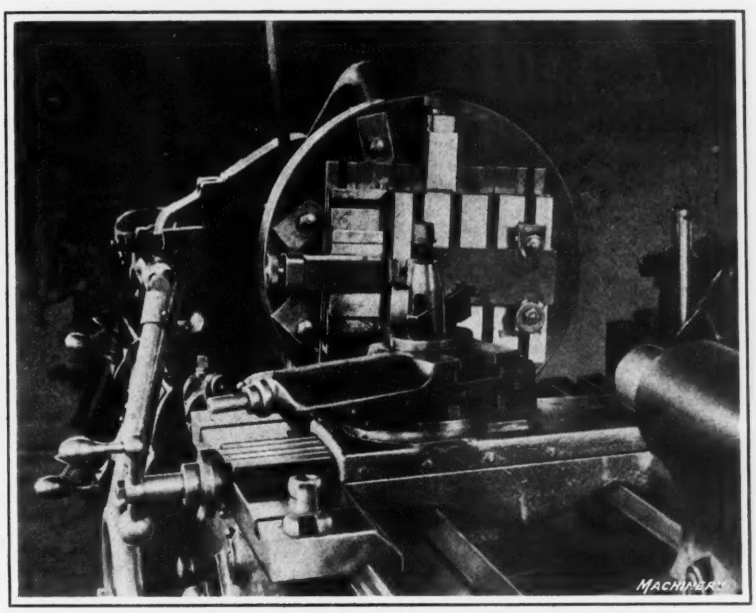


Fig. 4. Compound Slide used on a Lathe by attaching it to the Faceplate

Building Jigs and Fixtures on a Manufacturing Basis

Standardizing Various Details to Permit of their Production in Quantity at a Reduced Cost

By W. H. VOCKELL and H. C. UIHLEIN, The Cincinnati Engineering Tool Co., Cincinnati, Ohio

THE usual method of making the details entering into the construction of special tooling equipment is to design and machine each detail in the same manner as the more important parts of the equipment. That this is extremely wasteful and costly, on account of the high wages paid to labor at present, will be apparent from the facts presented in the following article, which describes the practice of the Cincinnati Engineering Tool Co., Cincinnati, Ohio. This concern has eliminated a large amount of the unnecessary time customarily involved in the design and building of jigs, fixtures, and similar equipment, by standardizing the more common details, manufacturing them in large lots, and withdrawing them from stock when required in the assembly of a jig or special fixture. While only milling fixtures are considered in this article, the principles laid down have also been applied to other equipment.

Example of Saving Effected by the Separate Manufacture of Common Details

Before deciding upon employing the method of manufacturing certain details in lots, a considerable amount of research work and calculations of machining costs were made, in order to determine whether the labor and money saved by the method would warrant the development of a line of standard details that would be applicable to various types of equipment. The following facts were revealed by this investigation and study: First, that, in general, 60 per cent of the details entering into the construction of a jig or fixture can be standardized; therefore, this percentage of parts can be machined in manufacturing lots and kept in stock for use as required. Second, that the average part can be machined in manufacturing lots at about 10 per cent of the labor cost involved when it is machined special for a job. Third, that to machine the main parts of an equipment takes only about 25 per cent of the total machining time required when all of the parts are made special for a job.

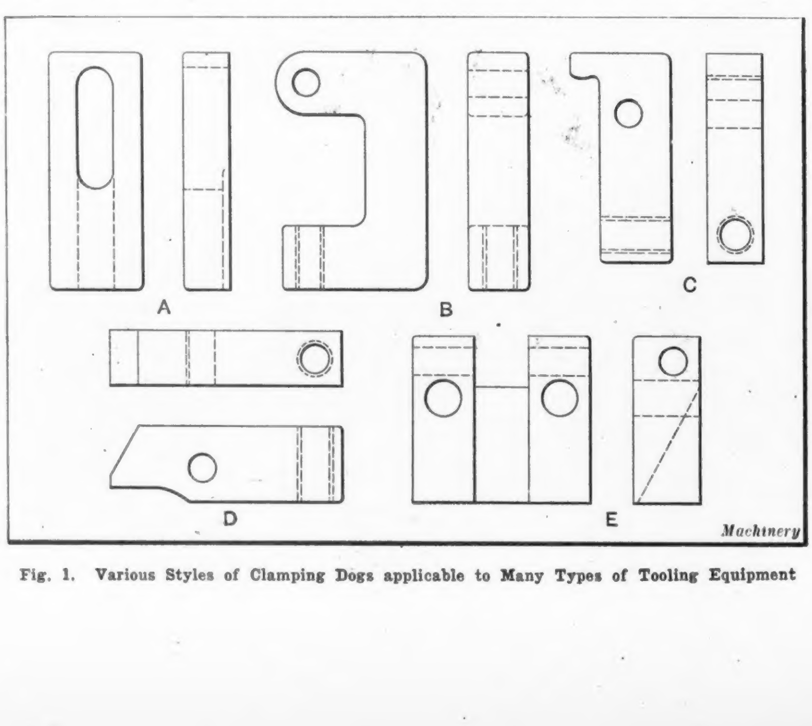


Fig. 1. Various Styles of Clamping Dogs applicable to Many Types of Tooling Equipment

The investigation did not include a consideration of the assembling time of an equipment, as it appeared that this factor would remain approximately the same for both methods of manufacture. However, actual results have proved that the assembling time is also shortened when certain details are standardized and manufactured in lots, this advantage being due to the fact that the parts are usually machined more accurately and that the workmen acquire greater skill by the repeated handling of identical parts. In order that an idea may be obtained of the saving in money corresponding to the saving in labor made according to the foregoing analysis, let it be assumed that the total labor cost of machining a complete fixture by the generally used manufacturing method is $500. A calculation can now be readily made of the amount of money saved when the majority of the details employed in such an equipment have been standardized and are manufactured in lots.

The third fact presented in the analysis is that 25 per cent of the total labor cost involved in the making of a jig or fixture may be charged to the machining operations on the main parts of the equipment. Thus, the cost of making the details by the method usually employed, that is, making each part special to suit the fixture, would be 75 per cent of $500 or $375. Next, according to the first fact, about 40 per cent of the details cannot be standardized, and 40 per cent of $375 equals $150. Subtracting this amount from $375 leaves $225, as the amount which the details that can be standardized would cost if made special for the job. The second fact in the analysis is that the cost of

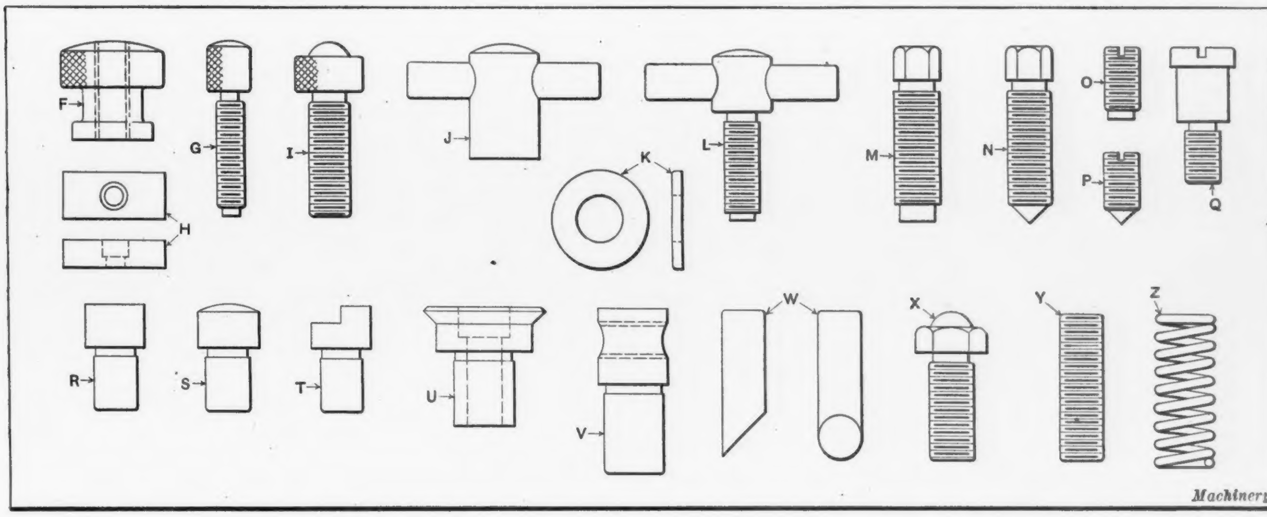


Fig. 2. Standardized Details made on a Manufacturing Basis for Use on Jigs and Fixtures

making standard details is only 10 per cent of the cost involved in making them special. Thus, 10 per cent of $225 is $22.50, which is the cost of producing the standard details in large quantities. Hence the saving in money on the $500 fixture resulting from standardizing the majority of details and then producing them in large quantities is equal to $225 minus $22.50, or $202.50.

In Fig. 1 are shown a number of styles of clamping dogs commonly used in jig and fixture construction, and which are considered as standard detail parts, while Fig. 2 shows a large variety of other standard detail parts. All the parts in both illustrations are made in large quantities and used as the occasion demands. Various types are given different stock numbers, and each one is carried in a sufficient number of sizes to cover the entire field for which it is intended.

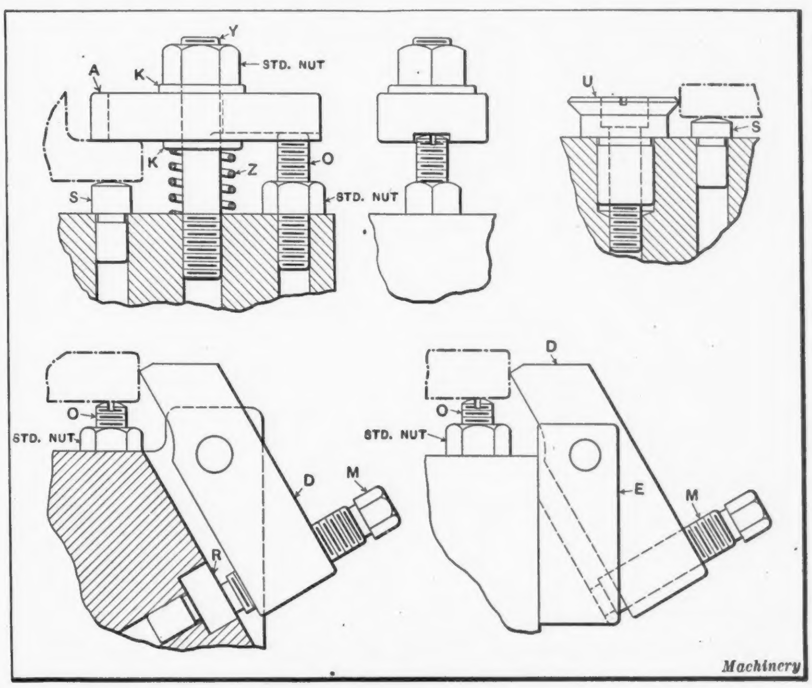


Fig. 3. Units developed from Standard Details which greatly reduce the Time spent in the Design and Detailing of Equipment

The advantages derived by manufacturing standard details in large quantities are actually greater than shown in the cost figures presented. The saving in the designing time has been entirely ignored, but, as a matter of fact, this saving is worthy of consideration. Standard units can sometimes be made up from the standard details, each unit being developed to perform a function common to most types of fixtures, such as for instance, a clamping arrangement. A number of such units are shown in Fig. 3 in which the reference letters refer to the standard details illustrated in Figs. 1 and 2. This illustration shows clearly the purposes for which some of the standard details are intended. Usually at least one of these standard units is applicable to the construction of an equipment, the result being a saving of all the time that would otherwise be expended in working up a device suitable for performing the function that is satisfactorily taken care of by the standard unit.

Another item that greatly reduces the cost of a fixture is the elimination of the necessity of making a drawing for

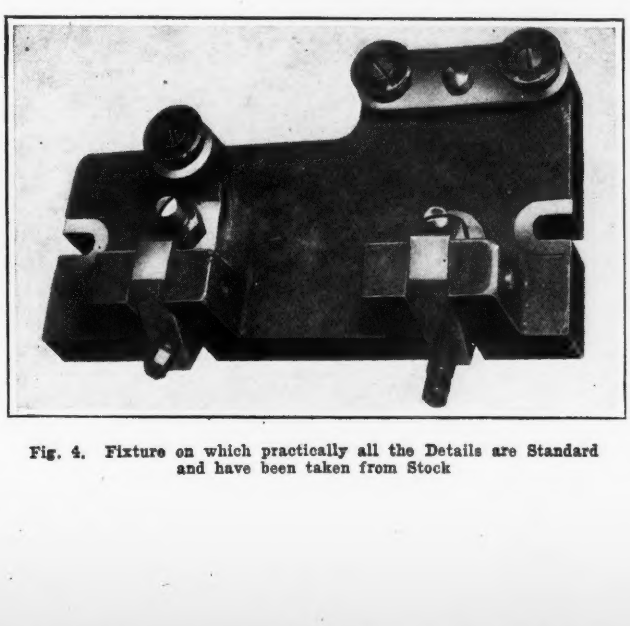


Fig. 4. Fixture on which practically all the Details are Standard and have been taken from Stock

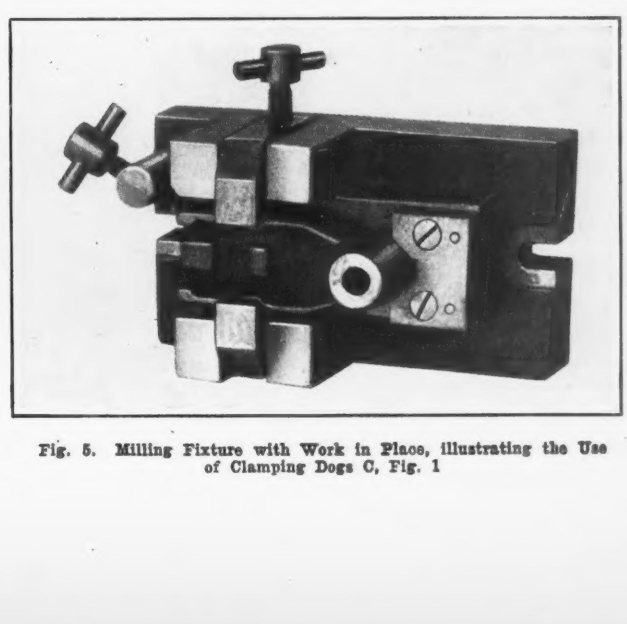


Fig. 5. Milling Fixture with Work in Place, illustrating the Use of Clamping Dogs C, Fig. 1

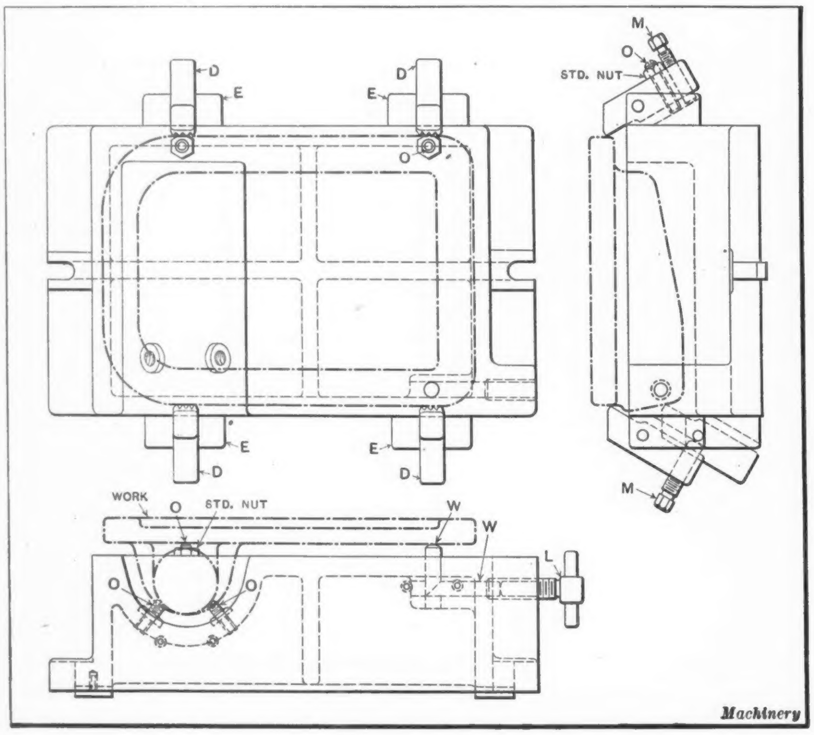


Fig. 6. Preliminary Drawing of a Milling Fixture developed for a Customer, in which Standard Details are used

each individual detail. After the preliminary design of an equipment has been developed, it is only necessary to detail the main parts entering into the construction, and those particular details which are not standardized, as all the standard parts may be called for on the preliminary drawing by the use of designated part or tool numbers. Continued study directed toward improving the various standard details also tends to improve the general design of an equipment, and in this way such designs are worked out to a finer degree than is probable when all the details are developed special for each job. The advantages of such a possibility will at once be apparent to toolmakers.

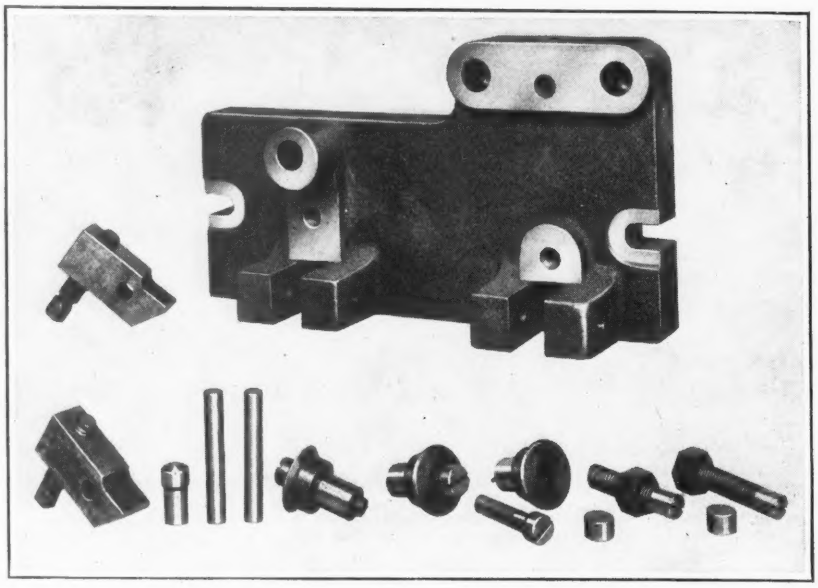


Fig. 7. Disassembled View of Parts of Fixture shown assembled in Fig. 4, the Standard Details being shown in the Foreground

A final point that is greatly in favor of developing standard details and machining them on a manufacturing basis is the delivery factor. An expeditious delivery of tooling equipment is usually desired and, as a consequence, the capacity of the toolmaking department of a plant is frequently overtaxed through the endeavor to rush the work through. By carrying a line of standard details in stock, quick delivery is possible. In the use of jigs and fixtures, the item of repair is of great importance, as production in a plant is often retarded because some detail on the tool, such as a broken clamp, bushing, etc., must be replaced. In the event of such occurrence, the interference with production is, of course, greatly lessened if the broken part is of a standard design that can readily be replaced from stock.

Supplying Standard Details to Customers

The results obtained by investigation and experience warranted the standardization of certain details and their manufacture in large quantities, but the difficult problem was to make prospective customers realize this fact so that concerns who wished to design tooling equipment and make the main parts themselves, and those details which could not be standardized, would be able to take advantage of the standard details made by the Cincinnati Engineering Tool Co. At first the attempt was made to have such customers refer to lists of the standard parts when designing their equipment, but this method did not prove successful, as considerable experience is required in the use of standard details before maximum efficiency in their employment can be obtained.

It was then decided that the following methods, which are now in use, would be the most satisfactory means of rendering service to customers: First, upon the receipt of an order, a preliminary design of the equipment is laid out, notations being made on the drawing of the standard details applicable to the jig or fixture. The stock parts and the preliminary design are then sent to the customer, so that he is in a position to complete the design and build the equipment, using the supplied stock parts in its assembling. Second, the design of the equipment is fully developed, together with the detail parts not contained on the standard lists. All the drawings and the suitable stock parts are then sent to the customer for use in building the equipment. Third, the design and necessary detail drawings are fully developed and the complete equipment built and shipped to the customer. The drawings are also furnished for use in replacing special details.

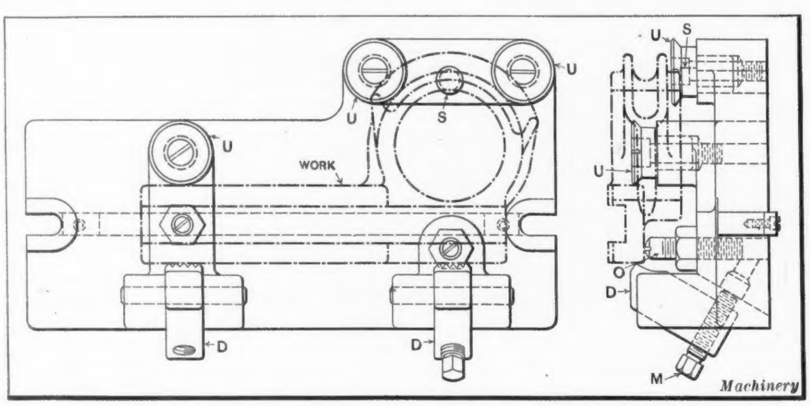


Fig. 8. View of Fixture shown in Fig. 4, with Work in Place

Fixtures to which Standard Details are Applicable

Fig. 6 shows the preliminary design of a milling fixture made for a customer under the first of the three methods outlined in the foregoing. In this illustration and successive ones, the various standard details are noted by the same letters as in Figs. 1 and 2. Upon receipt of such a design it is a comparatively easy matter for the customer to complete the essential detail drawings. In this case it was only necessary to fill in the required dimensions. This fixture is intended for use on a milling machine of the vertical type, and is employed to hold the work securely in place while a milling operation is being performed on the flange by a shell end-mill. When the casting is placed in this fixture, it first rests on four screws *O*, which are adjusted for the first operation on a lot of castings and are not touched during the completion of the order.

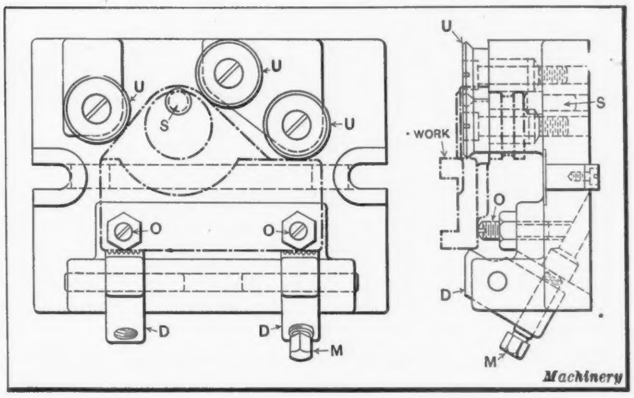


Fig. 9. Fixture employing Standard Details, Similar to that shown in Fig. 8

Pins *W* are then adjusted until the vertical one touches the bottom of the casting, the adjustment being made by advancing screw *L* into the tapped hole in which it is contained. This movement causes the wedging surface of the horizontal pin to bear against a similar surface on the vertical pin so that the latter is raised an amount depending upon the movement of screw *L*. After the vertical pin *W* has been set in place the screws of the two clamping dogs *D* at the front of the fixture are tightened by adjusting screws *M;* the two dogs at the rear are then tightened slightly in the same way. Screws *O* are provided on the two dogs at the rear so that although screws *M* on these dogs are loosened and tightened when work is removed or placed in the fixture, the positions of the two dogs will be approximately the same for each casting because the settings of screws *O* remain unchanged. The four dogs cause the casting to be brought firmly down on the supports provided and hold the casting securely during the milling operation.

A fixture designed for holding a rack bearing while a milling operation is being performed on the part is shown in Fig. 4. Nearly all the details and units on this fixture are standard, the only part made special for the job being the main casting. The same fixture is shown disassembled in Fig. 7, the various standard details and units being arranged below the main casting. An assembly view of this fixture is shown in Fig. 8, in which the position of the work when placed in the fixture is indicated by heavy dot-and-dash lines. It will be seen that the casting rests upon plug *S* and two screws *O*, the latter being used instead of plain plugs so that the height of these supports may be adjusted to suit the casting and plug *S*. The work is properly located by being forced against stops *U* when the clamping dogs *D* are brought to bear against the front side of the work, this action being accomplished by turning screws *M*. The large amount of time saved in making a fixture of this type when the majority of the parts can be taken directly from stock will at once be appreciated. Another milling fixture that is quite similar in design to that just described is shown in Fig. 9, the work being again supported by a plug *S* and two screws *O*, and forced against three stops *U* by means of two clamping dogs *D* held in lugs at the front of the fixture.

In Fig. 5 an assembled milling fixture is shown with the work clamped in place, use being made in this design of clamping dogs of the style shown at *C*, Fig. 1. An assembly view of this fixture which clearly shows all the details of its construction is presented in Fig. 10, in which the position of the work in the fixture is again indicated by heavy dot-and-dash lines. The left end of the work rests on two plugs *S*, while the right end is supported by a single plug *R*. The work is properly located through the use of the clamping screw *L* at the left rear corner of the fixture, which forces the boss at the right end of the work into the vee of a hardened block especially made for this fixture. The clamping screw also forces the front side of the left end of the work against a plug *S* placed in a horizontal position in one of the lugs supporting the dog *C* at the front of the fixture.

A fixture employed for holding short connecting-rods during the performance of milling operations is shown in Fig. 11. The work is supported on three plugs *S* in a similar manner to that employed in the fixtures previously dealt with, and is correctly located by being forced against three stops *U*. This action is made possible by the employment of a single clamping dog *D*, which is placed in a diagonal position at one end of the fixture.

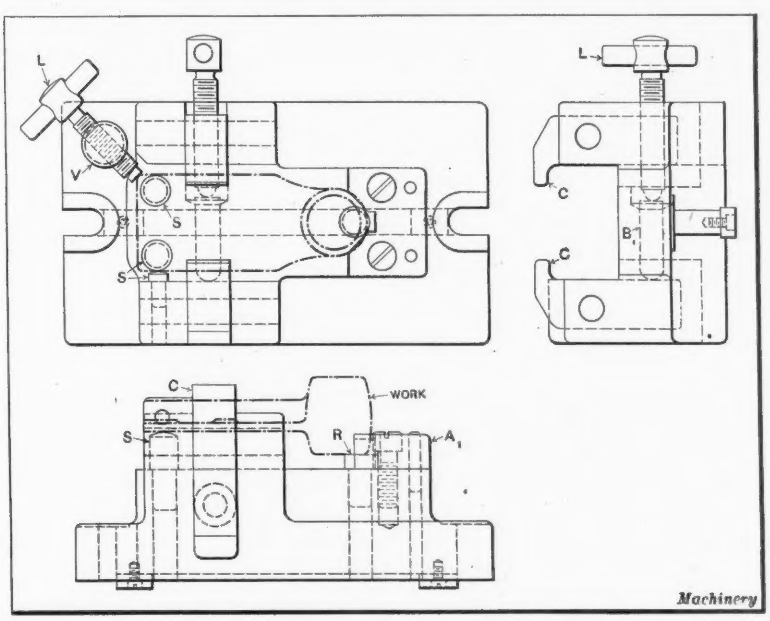


Fig. 10. Assembly View of Fixture shown in Fig. 5

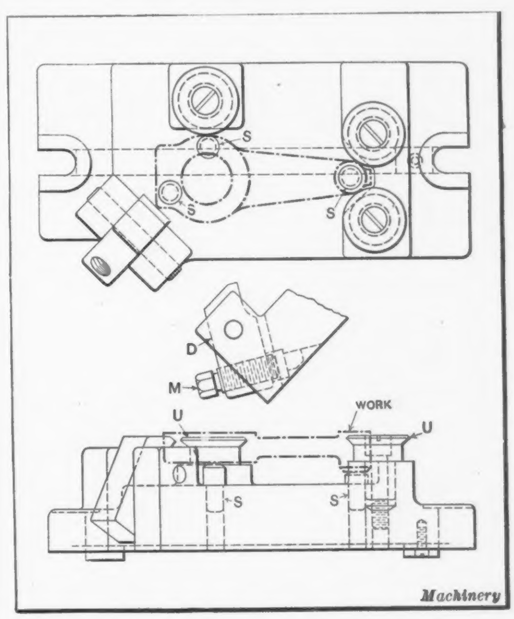


Fig. 11. Fixture that holds Work by One Clamping Unit

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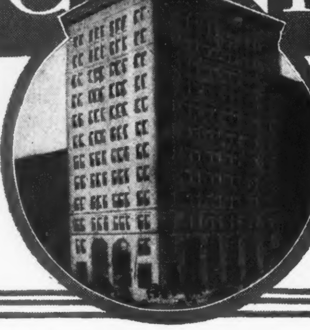


PRINTERS' WAGES INCREASED

While the cost of living in New York has fallen 14.9 per cent during the last half of 1920, according to the Bureau of Labor statistics, the wages of printers have been increased during the same period 11 per cent, the second increase in 1920.

These two increases in the labor cost of MACHINERY'S mechanical department equal the annual rent of five floors of the building shown above, totaling 50,000 square feet.

No wonder that publishers and employing printers want to move from New York.

* * *

KNOWLEDGE OF COSTS A PRIME NECESSITY

Manufacturers have never so urgently needed an accurate knowledge of costs as in these difficult days of readjustment, when all industries must be piloted through the troubled waters of changing economic conditions. In most industries prices must be readjusted on the basis of actual costs and a narrow margin of profit, and unless costs are definitely known, grave mistakes may be made. Price reductions are dangerous to the manufacturer who lacks an accurate knowledge of his costs. In the machine tool building field there has been a considerable amount of guesswork about costs, and the National Machine Tool Builders' Association is making determined efforts to impress on the industry the importance of this matter.

If an accurate knowledge of costs is to become general, some common standards must be established, defining and determining the items of outlay which constitute cost. The mere installation of a cost system is only the first step; that has been tried for years with indifferent success. There should be some concerted action to establish governing cost principles and to standardize cost system practices, and it is believed that the time is opportune for a nation-wide movement of manufacturers generally, to accomplish these objects. To promote this movement, the Industrial Cost Association has been organized, which many of the leading machine building plants in the country have already joined. The work of this association, of which M. F. Simmons, of the General Electric Co., Schenectady, N. Y., is president, is to be commended, and it is to the interest of all manufacturers to familiarize themselves with its aims.

* * *

RAILROAD SHOP CONTROL AND MECHANICAL EFFICIENCY

During the period of federal control of American railways, an agreement was made between the United States Railroad Administration and the men represented by the Railway Employes' Department of the American Federation of Labor and its affiliated organizations, which deprived the railroad machine shop foremen of authority to discharge or lay off men under their charge; and by making all promotions and other benefits received by the men contingent upon their seniority of appointment, a condition resulted which limits the progress and stunts the ambition of every such employe.

It has recently been suggested to the United States Railway Labor Wage Board that the provisions of the so-called "National Agreement on Working Conditions" should be abrogated or at least greatly modified. The changes suggested would eliminate many features which operate against the best interests of both the railways and their employes. Also, they would correct a condition which is unfair to the great majority of the public which is affected by diminished efficiency in railroad operation.

Lack of space precludes entering into a detailed discussion of many other features of this agreement which are equally objectionable; but to designers and builders of machine tools used by the railroads, there is one other point which naturally follows a consideration of these conditions of employment. During recent years, the skill and energy of machine designers and manufacturers have resulted in remarkable improvements in many types of shop equipment, with a view to improving the quality of workmanship and decreasing the cost of work incident to the maintenance of railway rolling stock in efficient operating condition. But it is futile to expect that such mechanical developments can offset the influence of a condition in the shops which prevents the development of men along broad lines of progress, and which hampers the proper direction of their efforts by those officials who are held responsible for results. The best interests of the railway shop employes, the railways and the public would be served by having the far-reaching and undesirable terms of this national agreement terminated as soon as possible.

* * *

CONCISE BUSINESS LETTERS

During the period of depression through which we are passing, one line of manufacture that appears to be quite busy is the typewriter industry. One manufacturer smilingly said the reason for this is that so few people know how to write concise business letters, and therefore twice the necessary number of typewriters are required to keep a business going.

There is much truth in this statement. Long and rambling letters are unfortunately too common. A letter using many more words than are necessary to express the writer's meaning is a waste not only of his time, but of the recipient's, and is likely to be misunderstood. The meaning of concise, to-the-point letters, free from repetition, is more easily grasped; and the reply, if one is required, is likely to be of a similar character. The lengthy circular letter, particularly, should be consigned to the waste basket. It has little value as a selling proposition, because it is seldom read.

The natural ability to set down their thoughts simply and clearly on paper is rare among business men, who have many other things to think of and seldom have received literary training; but it can be acquired by practice, and is well worth working for.

Quality Versus First Cost in Machine Tools

By A. H. INGLE, President, Betts Machine Co., Rochester, N. Y.

In this article, Mr. Ingle points out that with machine tools, as with everything else, it is not possible to get something for nothing. The purchaser who wants to buy quality in machine tools must be prepared to pay for it. Quality in a machine tool means better and more expensive materials, a higher grade of skilled labor in the manufacture, and more painstaking and time-consuming processes in the assembling and inspection. Hence, there may be a considerable difference in quality between two machine tools that are of the same size and general type, and it is not reasonable for the purchaser to expect that the two can be sold at the same price.

THERE is many a purchasing agent who expects to buy machine tools on much the same basis as he buys rails or pig iron—on a tonnage basis. He may not actually figure on the weight of the machine tool and expect that it should be priced accordingly, as has so often been done in the past, but when he is given the choice between, say, two lathes of the same size and type, he will often decide on the cheaper of the two, basing his decision on price only.

Now, in buying rails this may be all right. Rails made by different mills must meet certain standard specifications applying to all rails of a given size, and price becomes the only consideration. The same is true of pig iron, and of a great many materials as well as finished products that are ordinarily bought by purchasing agents for large corporations. But it is not true of machine tools, as everyone familiar with shop work knows. Yet the purchasing agents of some of our big railroad systems are not as familiar with this point as they ought to be, and often decide in favor of a cheaper machine without investigating whether the quality of the cheaper machine does not make it the most expensive in the end. The operator's wages and the cost of power and floor space and other fixed charges are substantially the same whether the machine is a highly productive one or not. The floor space occupied by a machine that does not produce sufficiently, particularly with present building costs, is an item of expense that absorbs a great deal more than the slight increase in the first cost of the right kind of equipment.

In Buying Machine Tools the Purchaser should Look to Production, not to Price

When buying a machine tool the purchaser is not really buying so many pounds of mechanism to place in his shop. What he is buying is production. The question in his mind should not be: "How cheap can I get this machine?" but "How cheap can I turn out the work for which I am buying this machine?" The difference in price of two machine tools of the same size and general type is seldom more than 20 per cent—more often it is not greater than 10 per cent. Yet, in ten or fifteen years the higher priced machine may easily turn out several times as much work as the cheaper machine. It is generally provided with better materials for its gears, and the quality and area of its wearing surfaces are better, and the proportions throughout more liberal. It will require less repairs and will stand idle fewer hours because of breakdowns. It will have steel gears where a cheaper machine may have cast-iron gears, and the teeth of the gears are not likely to be stripped. It will maintain its accuracy longer because its bearings are of better quality and more carefully designed and adjusted—briefly, it will last longer and give better service—so much so that the 10 or 20 per cent additional first cost applied in the purchase of such equipment would result in decreasing the ultimate cost of the product in many cases as much as 50 per cent, as compared with the cost if cheaper equipment had been used.

Every effort should be made to impress upon the buyer of machine tools who is not in close contact with the actual production of the shop that it is economical to buy on a basis of quality rather than on a basis of price. Price reductions often mean quality reductions, and in machine tools the best is usually the cheapest in the end. A machine tool is not bought for immediate consumption. It will stand in the shop year after year, and it will keep on producing according to the original quality in the machine. It is the length of its useful life that counts, not the first cost.

Building an Organization versus Buying Machine Tools

It is a curious fact that many an executive of a large corporation who has proved his ability by building up an excellent organization of capable men seems unable to realize that when it comes to the buying of machines, quality is as important in order that the right results may be achieved as it is in the hiring of men. He did not build up his organization by hiring the cheapest engineers, accountants, superintendents, and foremen that he could find. On the contrary, he built up his organization by trying to locate the very best men in each class; but when he comes to the buying of machine tools the procedure is different. He calls for bids from various manufacturers and whoever bids lowest often gets the order. He forgets entirely the question of quality, and thinks in terms of price only. As a result he fills his shop with mediocre machines incapable of turning out the full quantity of work for a sufficient length of time without repairs or breakdown; yet he doubtless considers himself a capable and shrewd business man because of being so clever a buyer.

Many a time the mechanical executives of large corporations have recommended to the purchasing agent the acquiring of equipment known to be of the highest quality, but the purchasing agent, finding that the machines specified by the mechanical heads are higher priced than some other machines that appear to him to be equal in size and appearance, buys the cheaper kind. If the mechanical executive is qualified to recommend the right equipment for the work, his judgment should prevail. If he is not capable and his judgment considered unsound, then he should be replaced by someone in whom confidence can be placed. An able mechanical executive's recommendations should be followed, because he would make them only after considerable time and effort had been spent in investigation.

To Maintain Quality should be the Slogan of the American Machine Tool Builders

In order to maintain quality with present cost of manufacture we must maintain prices, and we must try to impress upon the purchaser that it is good business to buy on quality rather than on price. The effort of American machine tool builders should be to produce the best machine tools possible, irrespective of cost, and then to make the purchaser realize that it is to his advantage to pay the higher price necessary in order to obtain a superior machine.

In small shops there is little difficulty in persuading the proprietor that it is to his advantage to buy good machinery, because he is usually a mechanic himself, or he is at least so close in touch with the shop and the productive end of

the business that he knows that it is not the first cost but the ultimate cost that counts. It is in the case of large corporations, and more especially in the case of railroads that the difference between machines of similar size and type is not thoroughly appreciated. The mechanical heads should have more to say about the selection of machines than they usually have, for they know that the better machine will produce more and will be cheaper in the end.

It is especially important in the selection of large machine tools that the question of results in production rather than first cost be the deciding factor, because of the large investment involved, the large space occupied, and the fact that many of the smaller machines are dependent on the output of a few large ones. Hence, the total production of the shop may be either accelerated or retarded according to the efficiency of a few big machines, and the small difference in first cost is the least important item to be considered.

Designers of machine tool equipment would be able to contribute more to the advance of efficiency in machine shop practice if they had greater freedom to design the best and most efficient machines, at all times, without any restrictions to meet the demand of the buyer who looks at price first and results second. The difference in first cost between a really good machine and one second in quality is soon recovered if the better machine is installed; whereas, if the cheaper machine is bought it will continuously hamper the output of the shop and act as a reminder that saving in first cost is often the cause of a continuous increase in production costs.

The many purchasing agents who investigate quality as well as price, and exercise the courage of their convictions in buying, are laying a foundation for substantial recognition of ability in their field, and the soundness of their judgment will become evident in no uncertain manner as the results show themselves in the form of greater production in the shop.

* * *

HOW LABOR AGREEMENTS COMPEL RAILROADS TO PAY FOR WORK NOT DONE

Following are two of the many instances cited in the hearings before the U. S. Railroad Labor Board in Chicago to show how the "National Agreements and Rules Working Conditions" brought into existence under federal control compel the railroads to pay large sums for time not spent by workmen in productive labor:

On the Cincinnati, Indianapolis & Western Railroad a mechanic was required to make a trip to an outside terminal for work which required about one hour's time. The man slept at the terminal all night, but upon his return to his home station claimed time and a half and double time for the period covered by his absence, causing the railroad company to pay him *$34.84 for one hour's actual work.*

On the Chicago, Great Western Railroad, a wrecking crew arriving back at its home station two days after it had left to clean up a wreck, put in claims for time and a half and double time during the night periods when they were not working, and notwithstanding the fact that the wrecking outfit was equipped with sleeping and dining facilities and the men were free to rest, sleep or eat from 9 P. M. to 7 A. M., they claimed and were *paid a total of 18 hours and 30 minutes pay, representing time while they were performing no work.*

These examples illustrate the practical workings of Rule No. 6 of Labor Agreements which the railroads are seeking to have abrogated. This rule provides: "All over-time outside of bulletin hours, up to and inclding the sixteenth hour of service in any one 24-hour period, computed from the starting time of the employe's regular shift, shall be paid for at the rate of time and one-half, and thereafter at the rate of double time, up to the starting time of the employes regular shift."

BILLS IN CONGRESS TO INTRODUCE METRIC SYSTEM

Bills have been introduced in Congress by Senator Frelinghuysen of New Jersey, and Congressman Britten of Illinois, proposing to fix the metric system of weights and measures as the single standard for weights and measures. These bills provide briefly that "from and after ten years no person shall do or offer to attempt to do any of the following acts, by weights and measures, in or according to any other system than the metric system of weights and measures, namely: Sell any goods, wares, or merchandise except for export as provided in section 12; charge or collect for the carriage or transportation of any goods, wares, or merchandise; charge or collect from or pay or reimburse any other person for work or labor which has been or is to be performed or done . . ."

It is further provided that "from and after four years no person shall manufacture or make for himself for use, or purchase for use any weight or measure or weighing device constructed, marked, or graduated in any other system than the metric system of weights and measures; that from and after ten years no person shall use or attempt to use any other system than the metric system of weights and measures; that from and after two years no person shall manufacture or pack, offer for sale or sell any goods in package form, which are required by law to be marked in terms of weights and measures, unless they be marked in or according to the metric system of weights and measures; that not later than ten years all postage excises, duties and customs charged or collected by weights or measure shall be charged or collected in or according to the metric system of weights and measures; that rules and regulations for the enforcement of this act shall be made and promulgated by the Secretary of Commerce."

In this connection it is of importance to note that a great many organizations have taken formal action in opposition to the compulsory use of the metric system in the United States. The resolutions which these organizations have passed are on record in the office of the American Institute of Weights and Measures, 115 Broadway, New York.

* * *

FINANCING FOREIGN TRADE

The Foreign Trade Financing Corporation, 66 Broadway, New York City, has been organized under the Edge Act for the purpose of assisting in the maintenance and further developments of the foreign trade of the United States. It is expected that the corporation will have a fully subscribed capital of $100,000,000 with a surplus of $5,000,000. Under the law the corporation may extend long- and short-term credits, invest in securities, purchase bills of exchange, engage in foreign banking, and in every lawful way aid in financing foreign trade.

It is expected that the corporation will furnish a much needed machinery for carrying on foreign trade requiring long-term financing. The proposal to organize the corporation arose out of the existing needs of industry and commerce for greater facilities for financing the purchase of American-made products by foreign customers. Many foreign buyers, even those most advantageously situated financially, suffered from the effects of the exhausting war, and are unable to pay immediately for adequate quantities of American-made products unless long-time credits are arranged for.

It is expected that the industries of the United States will aid in financing the corporation by the purchase of stock, and an invitation to subscribe is extended to all organizations and individuals representing agricultural, manufacturing, financial, labor and other interests throughout the United States. Further information may be obtained by communicating with the Committee on Organization, 66 Broadway, New York City.

Taxation and the Industries

By THEO. H. PRICE, Publisher "Commerce and Finance," New York

In his article "The Business Outlook for the Coming Year," that was published in the January number of MACHINERY, A. W. Henn, president of the National Acme Co., Cleveland, dealt briefly with the question of taxation and called attention to the method of taxation proposed by Theo. H. Price, publisher of "Commerce and Finance," which Mr. Henn stated appears to be free from most of the objections that have been raised to other proposed systems of taxation and which, in addition, seems to have many advantages. In the present article the method proposed by Mr. Price is outlined in greater detail. Manufacturers will be interested in this proposal, because the development of the industries depends very largely upon the methods of taxation.

EVEN though it be thought that the present taxes are against the public interests, it must be admitted that it is politically impossible to get them changed at once. It is probable that the excess profits tax will be repealed. It is possible that some reduction in the income super-taxes may be secured. It has also been suggested that the tax on earned incomes should be revoked, leaving "unearned" incomes alone subject to taxation. The unwisdom of attempting to discriminate between earned and unearned incomes will probably become apparent as the proposition is considered. It would drive capital into tax-exempt securities, penalize thrift, and encourage people to spend their earnings instead of saving them.

The Consumption, Sales, or Turnover Tax

The most favorably received suggestion thus far made for a substitute for the present excess profits tax is that of a consumption tax or a "turnover" tax. It is estimated that the agricultural, mineral, and industrial production of the United States is now worth an aggregate of about seventy billion dollars a year, and that in its passage from producer to consumer it generates a trade or commerce which involves a turnover of about five hundred billion dollars annually. A tax of one per cent upon this turnover would yield a revenue of five billions a year, which is nearly twice as much as we are likely to need in the future; a tax of one-half of one per cent would be sufficient and would not be felt appreciably by the individual consumer, so why not levy it and be done with it? It would collect itself, for it would only be necessary to require that everyone should send on the first of each month a statement of his sales, and a check for his taxes to the Treasury Department, and the buyer would hardly know that he was paying the tax, because it would be hidden in the price and absorbed in the seller's overhead charges.

Objections to the General Sales Tax

It all looks very simple, but let us examine it. Would it be politically possible to get Congress to pass a law taxing the farmer on what he receives for his crops? It is very doubtful. Would it be physically possible to compel the newsboy to pay a tax on the papers that he sells or the peanut vendor to make a monthly statement and send a check? Does the bootblack sell a "shine" or his labor, and would the latter be taxable? Is it freight room or service that we buy from the railroads and should either be subject to the consumption tax? Should the banker who sells hundreds of millions of securities be subject to a "turnover" tax that would break him, or be given an exemption that Congress would never grant?

These are just a few of the questions that suggest themselves, but they make it plain that the problem is one of infinite complexity. When the turnover tax was first proposed, it impressed me so favorably that I advocated its adoption; but when I came to think about a practical plan for its collection, I found that it would have to include innumerable exceptions, and that each exception made would inspire a demand that another class be exempted, until there would be nobody left to tax. I have therefore given it up, and my mind, still seeking some practical method of taxation that would be less injurious to the industries, has gradually turned toward a tax that would be levied on the total amount of wages and salaries paid by employers of labor. I believe that this is the nearest approximation to an equitably distributed consumption tax that we can obtain.

Taxation on Total Wages Paid

All that we consume and all wealth is the product of work. The banker's profit and the bootblack's pennies are alike the result of work. Speculation and judgment, the willingness to take risks, and the ability to select and limit them intelligently affect the reward that different men receive for doing the same amount of physical work, but these are elements that, being intangible, exempt themselves from taxation.

By and large, the great mass of things that mankind consumes is the product of work—on the farm and in the mines, in the factories and in the offices. Therefore, if the labor cost of these things were taxed we should approximate an equitably distributed consumption tax, and if it were supplemented by a reasonable income tax plus moderate surtaxes, we would, it seems to me, be getting about as near as we can to a fairly apportioned tax.

I am fully aware that there are a great many exceptions that would have to be made or would, so to speak, make themselves, in the application of this theory. The men and women who employed no household servants, as well as those who sold the product of their individual labor directly to the public, would be exempt, but I am inclined to think that this is desirable, for it would stimulate personal economy and industry.

Application of the Tax on the Payroll

The employers' payroll tax, while it would be paid directly by the farmer, the manufacturer, and the merchant, would be immediately passed on by a microscopic addition to the price of the article produced. It would therefore be almost invisible, it would be nearly painless and it would be promptly paid in small installments from day to day, or month to month.

A manufacturer or merchant whose monthly disbursements for wages, salaries, or piece-work totaled $100,000, would at the end of the month send a statement to Washington with a check for the amount of his tax. If the tax were 5 per cent, his check would be $5000, which he would include in his overhead charges and add to the selling price of his product.

The price paid by the manufacturer of an entirely finished or marketable product for the raw or partially finished material that he used would have been correspondingly increased by the employer's tax upon the wages paid to those employed in its production, and thus the price at which the

article was sold for consumption would include all the employer's taxes that it had to bear in its progress from the first producer to the ultimate buyer.

The Fiscal Point of View

As to the aggregate of the wages paid in this country, which would be the principal sum upon which such a tax could be levied, no definite figures are available. Roughly speaking, there are probably fifty million men, women, and children in the United States who sell their labor directly or indirectly. If they earn on an average $2 a day and work 300 days a year, the labor income of the country is thirty billions a year. This is hardly more than a guess, but if it is anywhere nearly correct, a tax on total wages paid that would equal 7 per cent on the total payroll would probably provide all the revenue we need to offset the reduction in the excess profits and income supertaxes for which we hope.

A Tax that would be Equitably Distributed

Such a tax would be paid directly by the employers and for the most part by the large employers. Where the work paid for produced the things that the people consume, the tax would be passed on in the prices charged; and in the case of those who employed others to lessen their own toil or minister to their comfort, luxury or extravagance, the tax could not be passed on and would act as a deterrent to unproductive expenditure.

I submit the suggestion for consideration. I realize that it is only out of the conflict of opinion that truth is evolved. There may be a great many objections to the proposed tax that I cannot see. Constant study of a single subject is apt to impair the vision. All that I hope or can expect to accomplish is to stimulate thought upon what is our most important domestic problem, and I am certain that a satisfactory solution can be found if the energies of the collective American mind are concentrated upon the subject.

* * *

TESTING MERITS OF HIGH-SPEED STEEL

By THOMAS FISH
President, Ready Tool Co., Bridgeport, Conn.

The writer's attention has been called a number of times, to the fact that there seem to be no facilities in this country for testing, *in a scientific way*, the merits of the various makes of high-speed steel. The writer has in mind some place where it would be possible to continue the work as laid out by the late Frederick W. Taylor, at the works of the Midvale Steel Co.

If some technical school, like the Massachusetts Institute of Technology would take hold of this, or if the American Society of Mechanical Engineers could provide facilities for the proper testing of high-speed steel, I believe that it would be invaluable to the large users of high-speed steel.

The Ready Tool Co., as a manufacturer of tool-holders, selling large quantities of extra cutters or tool bits in various forms, squares, flats, double bevels, and special shapes for threading tools is, of course, always interested in knowing of, and using, the best steel. We have the representatives of the large steel companies calling on us continually, stating the various tests they have made in different plants, and how their steel "did more work than any of the other twelve or twenty-four brands that the test was being run against"; but when you come to examine the report of the test, you find that no attempt was made to analyze the work that was being machined, no stated form of tool was used or maintained; and various ways of determining the value of the steels were used by different manufacturers.

One will take a sample piece of high-speed steel, and run it just as long as he can at a *very high speed*, which speed may be entirely impractical, as far as its use is concerned, but his theory is that if he can show on one grade of work that he ran two inches, where another high-speed steel only ran one inch at this high speed, then the one that ran two inches is double in value to the one that only ran one inch, regardless of Taylor's proof shown in his book, "On the Art of Cutting Metals," that this is in no way a proper test.

Other manufacturers will take high-speed steel at a *slow speed*, and run it *for days at a time* without sharpening; and if one high-speed steel will run three days, and another will run six, then, it is his opinion that the one that runs six days is worth twice as much as the one that runs three. In other words, there is not only no place for properly testing high-speed steel, but there is no standard being used for determining the results.

Taylor gave us an accurate report of his tests, showing that the average economical time that should be used for a tool was an hour and twenty minutes, before breaking down, but that for his test, he did not want to take up this amount of time, and that a twenty minute run was nearly enough correct to determine values in high-speed steel.

Of course, there is, in addition to this, another very important factor, that is, the heat-treatment of high-speed steel. In the writer's travels all over the country he has run across some peculiar methods of treating high-speed steel; there is no standard, and even the manufacturers vary considerably in their instructions for the heat-treatment of their own particular brand. It would seem that if the American Society of Mechanical Engineers, or some technical school, could take advantage of this opportunity, the benefits derived would be very valuable.

A proper size of lathe should be used, and properly annealed and analyzed cast iron and steel should be employed for the purpose of the test. Then, with proper equipment, and with correctly formed hardened and ground tools made from various makes of high-speed steel, tests could be run at predetermined feeds and speeds, and compared with other makes of steel, giving an accurate report of value.

It would, of course, be understood that each manufacturer having tools or steels tested would retain for his own personal use only the name of the steel he was having tested, so that no manufacturer would be injured by the report.

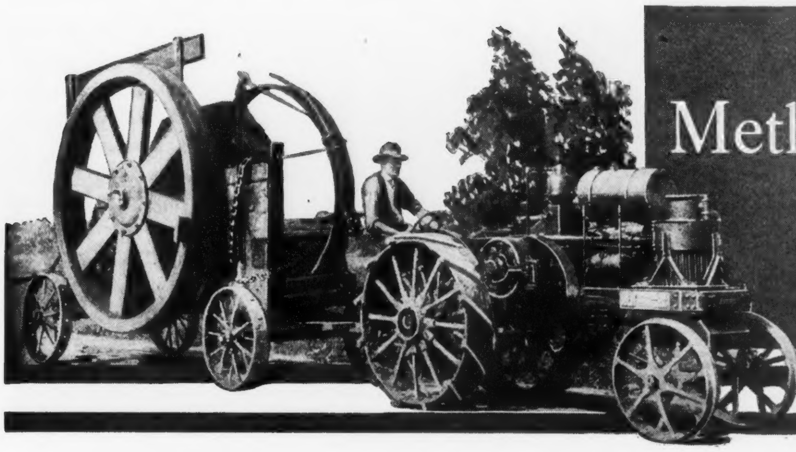
* * *

NATIONAL MACHINE TOOL BUILDERS' CONVENTION

The semi-annual convention of the National Machine Tool Builders' Association was held at the Hotel Cleveland, Cleveland, Ohio, February 24, 25, and 26. The meeting was originally scheduled to be held in May at Atlantic City, but a change in plans was made, because the executive committee had considered a number of enlarged constructive activities which might be undertaken by the association. It was in order that some of the features of this program might take immediate shape that the executive committee deemed it advisable to call an earlier meeting of the association for the purpose of discussing this enlarged program of work.

The association also had before it the consideration of the proper principles of cost accounting, this work having been carried through its preliminary stages by the firm of Scovell, Wellington & Co. It was deemed that an earlier meeting of the association than was at first contemplated would serve to crystallize association opinion concerning the value of this work, so that it might reach concrete form as soon as possible. The sessions therefore were devoted entirely to association business and no outside speakers were invited. There was no printed or formal program; but many topics of interest were presented by members for discussion, among which were the following: The present business situation and how to handle it; principles of sound financing for the machine tool industry; and how to run a machine tool shop in a time of depression.

The convention was well attended and the interest displayed by members in the new activities undertaken indicated the value of the increased activity of the association.



Methods in a Tractor Engine Plant

Machining Cylinder Liners on a Progressive Rotary Type of Boring Machine

On tractor engines built by the Avery Co., in Milwaukee, Wis., a practice is made of using what are termed "cylinder liners," namely, cylindrical shells that are fitted into the cylinder block to provide a bearing surface for each piston. The chief advantage of this form of construction is that when the interior of the cylinders becomes worn from service it is an inexpensive matter to remove these liners and substitute fresh ones in their places, thus restoring the cylinders to a new condition at a relatively small expense. For use in boring the cylindrical shells before they are assembled into the cylinder block, use is made of a special station type of boring machine which is of somewhat different design to many equipments constructed on the same general principles. This machine is shown in Fig. 1, where it will be seen to consist of a turret which carries both the boring spindles and the work-holding fixtures in which the cylinder liners are held.

Actually the term "progressive" boring machine would probably be more descriptive than the term "station type" that is generally applied to an equipment on which several pieces of work are set up and carried around a circuit from the loading station for the successive performance of the various machining operations that are required. In the regular station type of machine, the work moves intermittently, stopping under the sequence of tools, each of which performs its share of the required machining operations. While the pieces of work are at rest in their respective stations, the tools are fed down to the work. Each piece of work may also rotate independently of the main table on which the work-holding fixtures are mounted; or the work may be held stationary and the tools receive a rotary movement in addition to their reciprocating vertical feed movement. But in the case of the present equipment shown in Fig. 1, a casting is loaded at the starting point and the boring tool comes into contact with it, after which the boring operation progresses continuously as the casting is carried around the circuit; and when the work gets back to the loading station, the boring tool is withdrawn at high speed, so that the

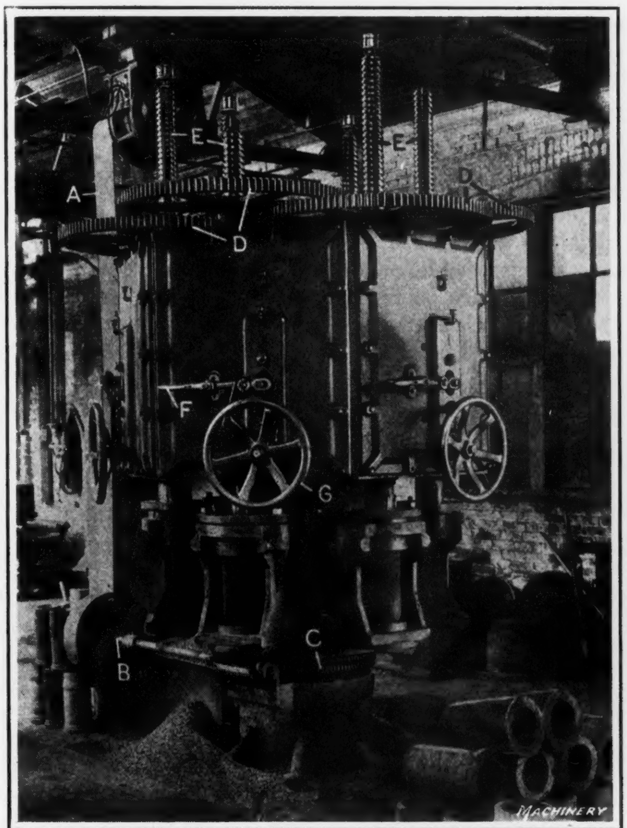


Fig. 1. Special Progressive Type of Machine used for Continuous Operation in boring Cylinder Liners for Avery Tractor Engines

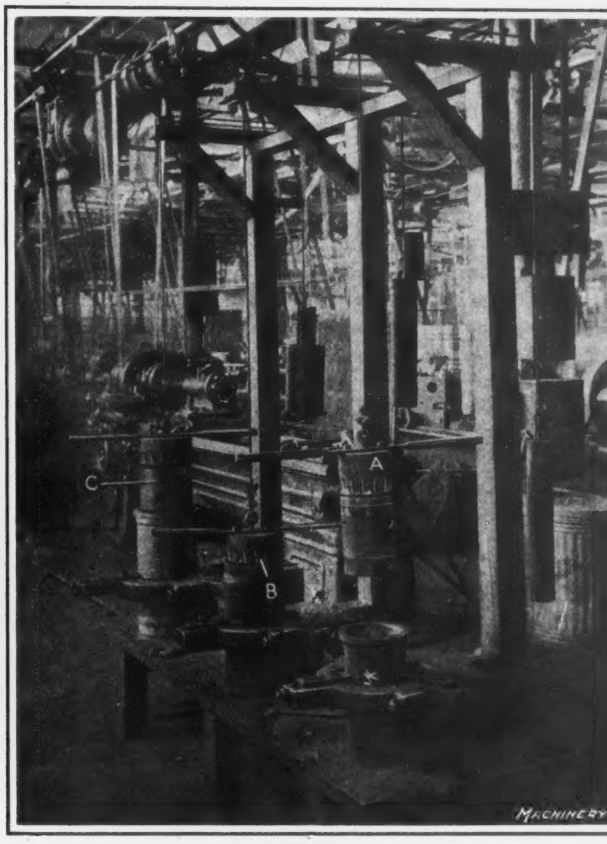


Fig. 2. Special Equipment used for chamfering Center Bearings on Tractor Engine Cylinder Liners preparatory to finish-turning

cylinder liner can be removed from the fixture and a new casting set up in its place. On this machine, the work occupies a fixed position on the rotary table and the boring tools rotate.

Mechanism of Progressive Rotary Boring Machine

With this preliminary statement concerning the characteristics of this machine, we are in a position to present a brief description of the mechanism by which the desired results are accomplished. It will be seen that power is furnished by a belt *A* from an electric motor mounted above the machine. This belt drives a pulley on horizontal shaft *B* that transmits the drive through a worm to a worm-wheel *C* secured to the base of the turret. As previously stated, this turret carries both the boring spindles and the work-holding fixtures, so it will be seen that the entire upper section of the machine rotates as a single unit.

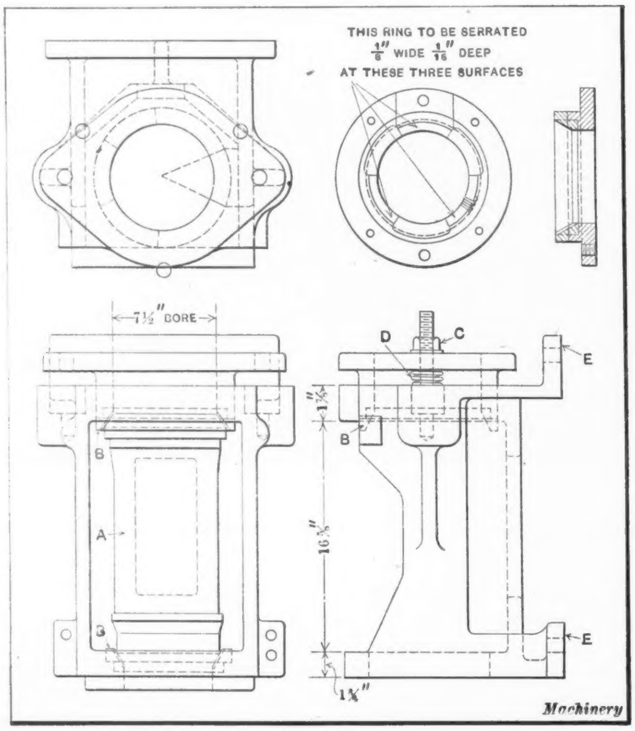


Fig. 3. Design of Work-holding Fixture used on Continuous Progressive Type of Boring Machine shown in Fig. 1

Extending up through the center of the turret, there is a vertical driving shaft which has a wide-faced spur pinion at its upper end that meshes with the large gears *D* which will be seen at the top of the turret. Each of these gears is splined to a lead-screw *E* at the upper end of one of the spindles, thus providing for rotation of the spindle and of the boring-bar that is carried at its lower end. These lead-screws also run through nuts, thus affording means of feeding the spindles downward to carry the boring-bars through the work. As the turret revolves, the work is carried around from the loading station, and the boring tool is fed downward until the operation in the cylinder liner has been completed. As each piece of work returns to the loading station, the direction of rotation of the screw *E* is reversed and the tool is backed out of the work at high speed. This result is accomplished by shifting the change-gears by means of lever *F*, which may be set in three positions to give a forward, neutral, or high-speed return movement. Wheel *G* provides for adjusting the vertical position of the spindle and boring tool by hand. Each spindle is independently controlled, and power is transmitted through an individual gear-box. In addition, there is a change-gear box that provides means for varying the speed at which the entire machine is driven.

Design of the Work-holding Fixtures

A good idea of the arrangement of the work-holding fixtures will be gathered from Fig. 1; and in Fig. 3 more detail is shown of the provision made for securing these fixtures to the machine, and for loading and clamping the cylinder liners in position for boring. In this illustration the work is shown at *A*, and it will be seen that there are serrated bell-mouthed bushings *B* at the top and bottom of the fixture, which serve the double purpose of locating the casting in a vertical position, and, by means of the serrations on these bushings, of biting into the edges of the work to prevent it from turning while the boring operation is in progress. This special boring machine was designed and built to facilitate production on the boring of cylinder liners, and bearing this fact in mind the work-holding fixtures were developed with special reference to the rapidity with which loading and unloading can be accomplished.

From Fig. 3 it will be seen that the method of procedure in setting up a piece of work for boring is to hold it in a vertical position and enter its lower end into the bell-mouthed bushing *B* at the bottom of the fixture. After this result has been accomplished, two nuts *C* are tightened down. These nuts bear against a flange located at the top of the upper bell-mouthed bushing *B* and provide for pushing it down on top of the work, sufficient force being applied on the wrench used on nuts *C* to insure having the serrations of the bell-mouthed bushings *B* bite into the work. Surrounding each of the bolts which connect the body of the fixture to the upper bell-mouthed bushing, there is a stiff compression spring *D*, and when nuts *C* are tightened down, the upper bushing slides into the fixture against the tension of these springs. Conversely, when the nuts are released, springs *D* raise the upper bell-mouthed bushing away from the work so that the bored cylinder liner may be lifted out of the fixture. The method of attaching the fixtures to the machine is quite simple. At the back there are brackets *E* through which bolt holes are drilled to provide for securing the fixtures to the faces of the turret that carries all parts of the mechanism.

Seasoning Castings after Rough-boring and Rough-turning

After the boring operation has been completed on the cylinder liner castings, they are transferred to a lathe and set up between centers to provide for the performance of a rough-turning operation on the outside diameter. The outer scale has now been removed from both the inside and outside of the work, and among men of experience in the machining of castings which are sufficiently thin so that even a moderate force might result in distorting their shape, it is a matter of quite general knowledge that the removal of the outer scale results in a readjustment of the internal strains in the metal, which may prove sufficient to cause a change of form. Particularly is this true in the case of thin castings that

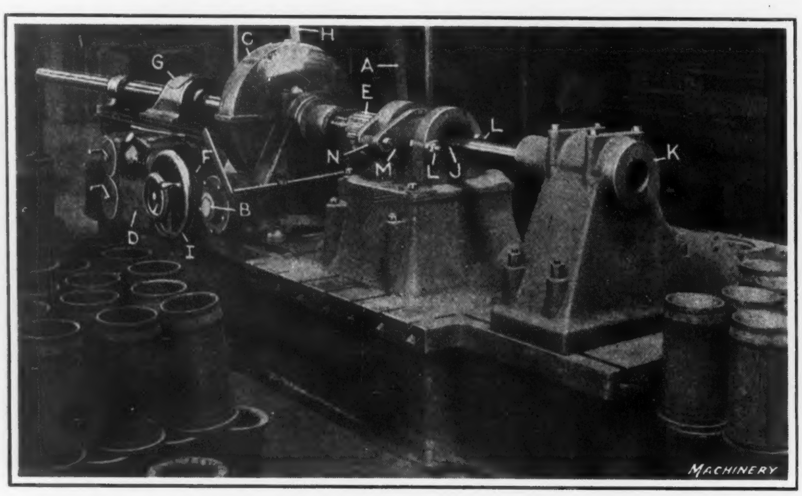


Fig. 4. Special Horizontal Machine for reaming Liners for Tractor Engines

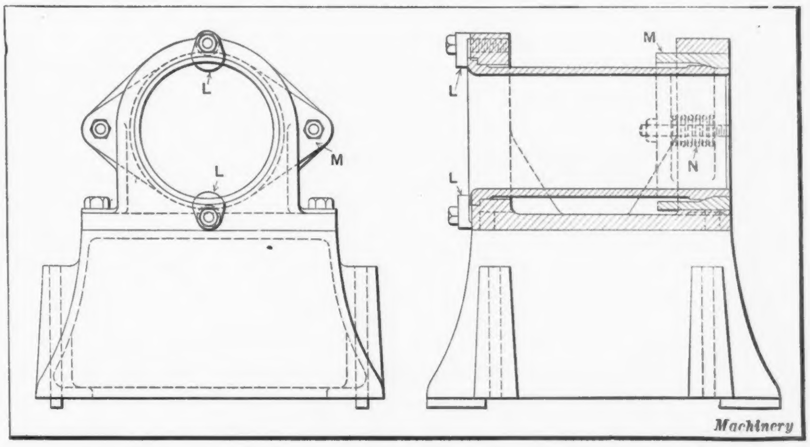


Fig. 5. Design of Work-holding Fixture used on Machine illustrated in Fig. 4

are of the same general character as the work that is at present under discussion. In order to assure the attainment of accuracy in the finished product, it is necessary to allow sufficient time for the effect of these new strains in the metal to become permanent before the finishing cuts are taken; and for that purpose, a practice is made of allowing the rough-turned castings to stand for a period of three weeks before starting the finishing operations, in order that they may be thoroughly seasoned.

Special Machine for Reaming Cylinder Liners

When the castings have stool for a sufficient time so that there is no danger of any further change in form, they are sent to a special horizontal reaming machine shown in Fig. 4, on which a finishing cut is taken on the inside of the work to assure having the bore straight and of exactly the required diameter. It will be seen that there are two belts coming down from the overhead works to provide for driving this reaming machine. Belt *A* runs over a pulley mounted at the end of a transverse shaft *B* on which there is mounted a worm meshing with a worm-wheel contained in case *C*; this worm-wheel is splined to the spindle and provides for driving it at a suitable speed of rotation.

At the back of the machine there is a horizontal belt (not shown) that transmits power to a transverse shaft that carries movement through to a feed-box *D* located at the front of the machine. This box provides for furnishing to the reamer *E* the various movements that are necessary for the performance of the required reaming operation in the cylinder liners. From the feed-box, the drive is through a worm and worm-wheel *F* to a lead-screw mounted inside the bed of the machine, which imparts movement to a sliding carriage *G* that is secured to the horizontal boring-bar. By means of gear shifts accomplished by the manipulation of the feed-box levers, provision is made for obtaining slow forward and reverse feed movements, and fast forward and reverse feed movements. There is also a neutral position for each lever on the feed-box.

At the back of the machine there will be seen a second belt *H* coming down from the overhead works. This belt runs over a pulley at the end of a transverse shaft, and provides for furnishing rapid forward and reverse traverse movements for the spindle of the machine, when it is required to quickly adjust its position. The pulley driven by belt *H* rotates continuously while the machine is in operation; and when it is required to utilize the traverse movement, this result may be accomplished by the engagement of a clutch that is manipulated by turning handwheel *I*. Then the traverse movement comes direct from belt *H* to the worm and worm-wheel *F*, and thence to the lead-screw. When the slow feed movements are required, handwheel *I* is turned to release the clutch, and the drive then comes from belt *A* through feed-box *D* to the same worm and worm-wheel *F*, and thence to the lead-screw, as previously described. The traverse and feed movements are interlocked so that conflicting movements cannot be engaged simultaneously.

Design of the Rapid-action Work-holding Fixture

Fig. 5 shows in more detail the arrangement of the work-holding fixture provided on this cylinder-liner reaming machine. As in the provision made for the holding of these castings for rough-boring, care has been taken to provide a means of accurately and rapidly setting up the work, so that production need not be unnecessarily retarded. At the time that the casting is being set up, the guiding pilot *J*, Fig. 4, at the forward end of the boring-bar has been withdrawn so that the casting may be lowered between the open end of the fixture and the inner end of the guide bushing *K*, and pushed back into the fixture. Then two small straps *L* are tightened to push the casting back, so that its inner end engages a bushing that carries a flange *M*. Tightening of straps *L* results in pushing this bushing and the work back against the resistance offered by two compression springs *N*, the tightening of the straps being continued until assurance is obtained that the back of the flange of the work is against the bottom of the counterbore in the fixture. After the reaming operation has been completed and the pilot *J* withdrawn, it is merely necessary to loosen straps *L*, and springs *N* will then push the casting out of the fixture for a sufficient distance so that the operator can take it in his hand and lift it off the machine.

Centering the Cylinder Liners for Finish-turning

In assembling the liners into a cylinder block, there are fits at each end of the liner which are seated in the block, but the main wall of the liner does not come in contact with

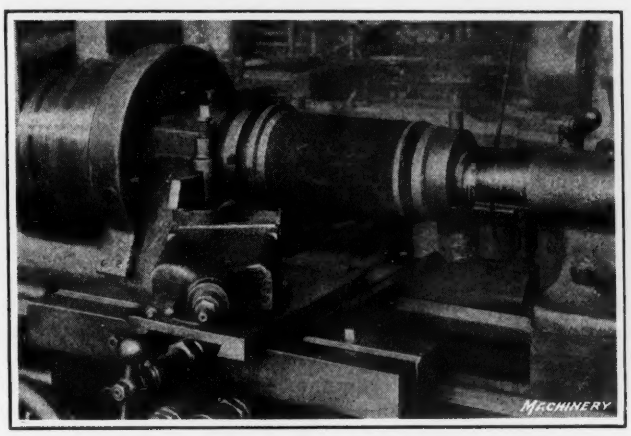


Fig. 6. Engine Lathe used for finish-turning Avery Tractor Engine Cylinder Liners

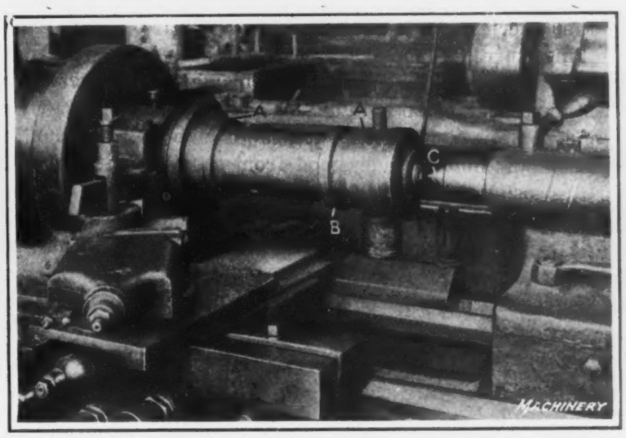


Fig. 7. Special Centers used for holding Work on the Lathe illustrated in Fig. 6

the block. Hence, it is only necessary to finish-turn the outside of the liners where they engage the cylinder block. These finishing cuts are taken with the work held on centers, and it is necessary to chamfer the inside edges of the shell in order to be sure of having them properly fit the special centers used on the lathe on which the finish-turning is done. Fig. 2 shows the equipment used for the performance of these chamfering operations, and from this illustration it will be seen that while the work is done by hand, the cutters are especially supported so that not only can the work be done as rapidly as possible, but a minimum physical effort is required of the operator. The same man who oper-

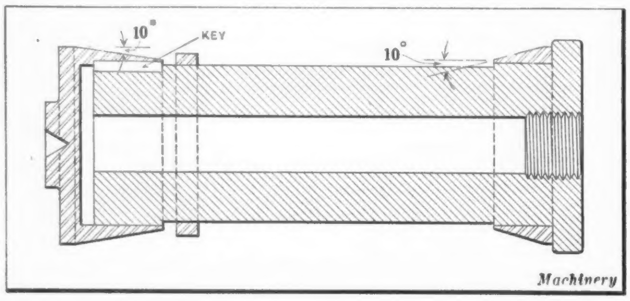


Fig. 8. Cross-sectional View showing Design of Lathe Centers illustrated on the Machine in Figs. 6 and 7

ates the reaming machine shown in Fig. 4 is required to chamfer the cylinders.

Referring to Fig. 2, it will be apparent that each of the cutters *A*, *B*, and *C*, is furnished with a guiding pilot that enters the reamed interior of the work; also, these cutters are suspended by cables which run over pulleys on a specially constructed framework, so that counterweights may be employed to balance the weight of the cutters and thus require the operator to merely apply sufficient force to overcome inertia and to turn the cutter after entering it into the work. Cutter *A* is shown suspended in its highest position, cutter *B* has been pushed down so that the pilot has fully entered the work and the blades are ready to start performing the chamfering operation, and cutter *C* is illustrated with the pilot about half way into the work. Also, it will be noticed that the castings are held by lathe steady-rests and that the castings under cutters *A* and *C* are standing in one position, while the casting under cutter *B* has been reversed end for end from that position. After each casting has been chamfered at one end, it is taken out of the chuck, reversed, and reset in order that the opposite end may be chamfered. Then the casting is ready to be sent to the lathe on which the finish-turning operation is performed.

Performance of the Finish-turning Operation

A statement has previously been made concerning the finish-turning operations which are performed at opposite ends of the cylinder liner castings, and it was explained that the reason for taking such cuts is to provide for fitting the liners into the cylinder block. Fig. 6 shows an engine lathe built by the American Tool Works Co., Cincinnati, Ohio, on which the finish-turning operation is performed, and in Figs. 7 and 8 there are shown the centers that engage the surfaces chamfered for that purpose by the tools illustrated in Fig. 2. There is one point in connection with the design of these centers which might not be understood from the illustrations without the assistance of the following description, namely, that the conical surfaces *A* which engage the chamfered inner edges of the work are solely responsible for its location and support. From the illustration it would appear that collar *B* also engages the finished bore, but actually such is not the case. However, this collar does serve as a guide to assist in pushing the reamed cylinder liner over that portion of the center to the left of collar *B* at the time the work is being set up.

After the liner has come in contact with the left-hand conical surface *A*, the right-hand cone center *A* is slipped over the outer end of the fixture and pushed up into the chamfer at the right-hand end of the bore in the work. Then the regular lathe center *C* is advanced into a center hole at the end of this right-hand cone *A*, and by tightening up the tailstock spindle against the work, provision is made for holding the casting ready for finish-turning. Obviously, the chamfered ends of the bore were accurately located relative to the reamed bore of the work by means of the piloted cutters shown in Fig. 2. Hence, with the work set up in this manner, it will be evident that the finished surfaces at the outside will be accurately located relative to the bore. Possibly a better idea of the arrangement of the centers will be gathered from Fig. 8. In addition to their use for locating the liners in the cylinder block, the seats that are finish-turned at this setting of the work are utilized as locating points for setting up the liners on a planetary grinding machine on which the final operation in the bore is performed.

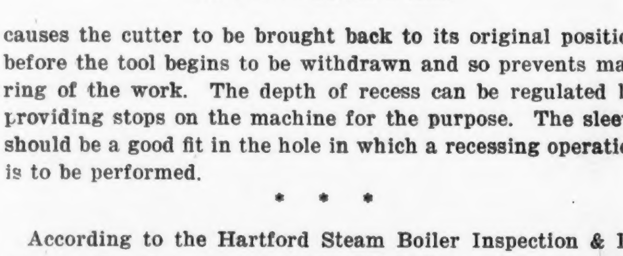
* * *

RECESSING TOOL

By HARRY MOORE

A recessing tool that can be advantageously used on turret lathes or drilling machines is shown in the illustration. In order to make its operation more readily understood, a description of its construction will first be given. Shank *A*, which is attached to the turret of a lathe, or to the spindle of a drilling machine, is milled square on that portion which enters sleeve *B*, there being a sliding fit between the two parts. If preferable, this portion of the shank could also be round and have two keyways engaging keys in the sleeve. Cutter *C* is held in a slot milled across the end of sleeve *B* to the same depth as the length of the cutter. The cutter is a sliding fit in this slot. The cutter is provided with a slight clearance to prevent marking the work and is chamfered at *D* to provide chip clearance. Sleeve *B* has a similar chamfer. The cutter is attached to the shank by means of pin *E*.

In operation, the tool is fed into the hole in which a recess is to be produced, spring *F* exerting sufficient pressure against the sleeve to insure that the cutter will be held in the position illustrated. When the bottom of the hole has been reached, as the shank continues to advance to overcome the action of the spring, the cutter is forced radially outward by pin *E*. The recess is formed by rotating either the cutter or the work as the cutter is forced outward in the manner described. In removing the tool from a finished hole, spring *F*



Tool used on Turret Lathes or Drilling Machines for forming a Recess at the Bottom of Holes

causes the cutter to be brought back to its original position before the tool begins to be withdrawn and so prevents marring of the work. The depth of recess can be regulated by providing stops on the machine for the purpose. The sleeve should be a good fit in the hole in which a recessing operation is to be performed.

* * *

According to the Hartford Steam Boiler Inspection & Insurance Co., there were in 1919, 528 boiler explosions in the United States in which 530 persons were killed or injured. This was an increase in the number of explosions of 79 over the previous year, and an increase of 57 in the number of persons killed. With all the efforts that are being made to provide safety in steam plants there is yet much to be done.

Machine Shop Training for Salesmen

Methods Used by the Norton Company, in Providing a Practical Training for Grinding Machine and Grinding Wheel Salesmen

By JOHN C. SPENCE, Superintendent Grinding Machine Division, Norton Co., Worcester, Mass.

IN previous numbers of MACHINERY, the principles involved and the methods used in training operators for the shop, as based upon the practice of the Norton Co., Worcester, Mass., have been dealt with. The training department maintained by this company has a much wider scope, however, than that indicated by the former articles. In addition to the shop training course, it includes a course for training salesmen both of grinding machines and of grinding wheels and abrasives. This training course is known as the "Grinding Course," and is divided into two subdivisions—the course for the training of grinding machine salesmen and the course for grinding wheel salesmen. The careful manner in which the Norton Co. prepares the men who are to sell its product is of great interest, because there is no doubt that a salesman who is properly trained in the actual use and care of the product that he sells can be of greater service to the customer than one who lacks direct and intimate practical knowledge of the product that he handles. It is the object of the present article to outline briefly the training methods used and the scope of the training. In so doing, the subject will be divided into two parts—the training for grinding machine salesmen, and the training for grinding wheel salesmen.

Grinding Machine Training Course

The object of the grinding machine training course is primarily to prepare men for field work as service men, demonstrators, and salesmen of grinding machines. In addition, this course is open to salesmen employed by agents selling Norton grinding machines, and is intended to familiarize these salesmen with the various types and sizes of grinding machines and attachments, as well as to acquaint them thoroughly with the details of the design of the Norton Co.'s machines and to teach them the proper methods of grinding as advocated by the company. The grinding machine course is also open to men employed by customers of the Norton Co., who wish to have the users of grinding machines trained in the proper principles and practices of grinding.

Preparing the Future Demonstrators and Salesmen for the Training Course

When a candidate having the proper qualifications has been accepted for the training course, he is turned over to the training supervisor, R. J. Spence, by the educational director, Professor A. D. Butterfield. The supervisor, in a talk with the prospective demonstrator or salesman, gives him an outline of the work involved in the training course, explains to him the rules and regulations of the department, and gives him a general idea of the safety precautions applying to the various departments in which he will work. An idea of what will be expected of him in the line of personal conduct is also given. After this preliminary talk he is furnished with a competent guide and taken through the entire plant, so as to obtain a general understanding of the manufacturing operations.

In subsequent talks, the applicant is told about the origin of the company, its founders, its growth, its present officers, its products and general policies, and its standing in the industrial world. The beginner is told what alundum is in its natural state, and the processes that it passes through before it reaches the Worcester plant are briefly described. In the same way, crystolon is dealt with, together with a number of other things relating, in a general way to the abrasives used in the grinding wheels made by the Norton Co. The prospective salesman is also given a general idea of the administration of the company, and is briefly told of the functions of the various departments.

Beginning the Training Course

After these preliminary talks, the training supervisor takes the beginner to the foreman of the first department in which he is to work, previous notice of his coming having been sent to the foreman. The foreman explains in a detailed discussion the operations for which the department is responsible, and the dangers to be guarded against in the work in this department are pointed out. A competent instructor is then assigned to the student, and the training supervisor turns him over to the department; but from time to time the supervisor visits the student while he is at work, and keeps in touch with the foreman, instructor, and some reliable fellow-workman regarding his progress. The same method of introducing the student to every new department is followed.

Reports and Records

The student is required to furnish a weekly report, and at the conclusion of his assigned work in each department a complete report covering what he has learned is expected within one week of the completion of the work. On the first of each month a report on the progress of the student is sent to the president of the company, containing the impressions of each member of the training department with regard to the man. Copies of this report are also furnished to other executives directly interested in the demonstrators and salesmen.

Outline of Course

The grinding machine training course is carried on according to a carefully worked out schedule, requiring a sufficient length of time in each department to insure that the student will receive a thorough knowledge of the machines and attachments made by the Norton Co. and their operation. The average length of time of training in each department is fixed, but the skill and aptitude displayed by the student is taken into account, and sometimes the course may be made either shorter or longer, according to circumstances. This is especially true of the time of training in the grinding practice departments. The total time for the training course is about ten months.

The first week is devoted to wheel manufacture, during which time the student is taught how to bush wheels, how to test them for speed, balancing, grading, and wheel inspection. The general principles of packing and shipping are also taught.

The student then begins on the main part of the course, devoting about four months to cylindrical grinding practice including the grinding of straight cylindrical pieces, fitting tapers, steadyrest work involving the grinding of long slender shafts, and production grinding. Later, one week each is devoted to crankshaft grinding, surface grinding, and tool and cutter grinding, and two weeks to master cam generation and cam grinding. Two weeks are devoted to operating the Norton running balance indicating machine, after which the student is transferred to the assembling department

where units for Norton grinding machines are assembled. Here he spends about two months in assembling the headstocks, footstocks, aprons, power-feed mechanism, surface grinding machine units, cam-grinding attachments, speed frames, and dynamic balancing machines. Two months are then spent in the erecting shop in the assembling of plain grinding machines, double-head crank machines, and surface grinding machines.

The next step in the course is a week in the machine inspection department in the running-off of machines and countershafts; and two weeks in the engineering department, where the student will be engaged in cam lay-out and be shown general lay-outs for machine and crankshaft equipment and where he will have the theory of the design of the machines explained to him. A week is later spent in the sales engineering department, where the student is taught the general principles of the running of this department and becomes thoroughly conversant with the relation of this department to the salesmen and demonstrators. He is shown the different files, and taught how the records relating to the company's engineering work are preserved. Finally, he spends a couple of days in the sales department, during which time he is taught the sales policies of the company, and is then sent on field demonstration trial work for at least four weeks.

Throughout the course, talks on engineering principles, principles of grinding, and grinding practice, are given to the students by Charles H. Norton. In addition, every Saturday morning, lectures are given by various executive department heads, salesmen, and foremen, which are attended by the student and which cover a variety of subjects, such as sales policies and sales problems, billing and collections, packing and shipping, contracts and agreements, knowledge of product as a basis of successful sales work, deliveries, precision grinding, etc.

Training Salesmen to Write Letters

An interesting part of the course is the training in the handling of correspondence. So-called "letter problems" are put to the students, and they are taught how to handle difficult situations and to understand the company's policy under different conditions. The manner in which this is taught is quite unique; an actual letter is given to the student from the files, and he is requested to answer it in such a manner as he would deem satisfactory. The actual reply that has been made to the letter is then shown to him for comparison, and if his reply differs from the actual reply, the matter is thoroughly explained to him and reasons given to show him why the letter should be replied to in a certain way. This method of training men to write letters for which the firm becomes responsible is an exceedingly good one. One of the most serious things to any firm employing a large number of men, each of whom carries on independent correspondence with outside customers, is the difficulty of having all the correspondence conform to certain uniform rules and of getting the men trained in tactful letter writing.

Course for Training Grinding Wheel Salesmen

The course for training grinding wheel salesmen is the same in principle as the one for training grinding machine demonstrators and operators, except that it differs in the actual length of time taken in different departments. The grinding wheel salesmen, of course, are given a longer training in the wheel department and a shorter training in the machine department. They spend between two and three weeks on truing and bushing wheels and on wheel inspection, and then five weeks in the stock department, where they are expected to become thoroughly familiar with the shapes and sizes of the wheels made by the Norton Co. They are expected to commit these shapes and sizes to memory, and also to know the wheels that may be used as substitutes for other wheels, if for some reason the exact wheel recommended may not be available for immediate delivery. The student is subjected to a written examination at the end of his stay in the stock department.

The next step in the training includes a general machine shop course covering three months, during which time the student is taught bench work and the operation of lathes, milling machines, shapers, and drilling machines. Three weeks of this time are spent in the regular production department. The next training involves grinding practice—a course covering three months, similar to the one given to the grinding machine salesmen, as already outlined. Another month is spent in master cam generation and grinding and in the engineering department. Later four months are spent in the mechanical laboratories, after which about two months are spent in the various office departments. The same lectures as are outlined for the grinding machine salesmen are attended by the grinding wheel salesmen.

A Course for Office Assistants

Outside of the courses for demonstrators, salesmen, and customers' wheel and machine users, the company has inaugurated a brief course covering about five weeks for training office assistants in the different processes in the shop. It has been found that if the men in the office have an idea of the general shop routine and the shop processes, they can answer correspondence much more intelligently and know what they are writing about to customers. They also become familiar with technical and trade names, and this training is really necessary in order to have a staff that can intelligently handle the office work. This course includes a brief stay in each one of the main departments of the plant, including three weeks in the stock department with a view to becoming thoroughly acquainted with all the sizes and shapes of wheels made by the company.

Training Customers' Wheel Users, and Agents' Salesmen

It will be seen from the foregoing that the training of demonstrators and salesmen for the Norton Co.'s own staff requires something like ten months. So long a period of time is generally too long for agents' salesmen, and the course is abbreviated to fit the needs of the individual, the time usually being from three to twelve weeks. The customers' wheel and machine users receive a training that is also fitted to the needs of the individual and which may be extended from one month to one year.

It is evident that training courses such as outlined make it possible for the company to serve its customers in a more efficient manner than if salesmen and demonstrators had not been so thoroughly and systematically trained. The departure of the Norton Co. in establishing such complete educational and training departments is in accordance with the trend of the times, it being recognized that service must be rendered in connection with the product, no matter how valuable the product may be in itself.

* * *

COPPER-STEEL

In a paper read before the American Iron and Steel Institute, E. M. Buck reviews the development of copper-steel, stating that tests made by a committee of the American Society for Testing Materials with the cooperation of the United States Bureau of Standards, together with other data available, prove that by alloying from 0.15 to 0.25 per cent copper with normal open-hearth or bessemer steel the rate of corrosion of steel is very much reduced, where the products are exposed to alternate attacks of air and moisture. It is also claimed that in the investigations indications pointed to a better adherence of paint coatings on copper-steel, resulting in a more effective and longer-continued protection by the paint film. The manufacture of copper-steel has heretofore been largely confined to sheet metal, but it might be extended to other uses. In particular, steel freight cars are mentioned, especially those of the open kind, which are greatly affected by corrosion.

System for Production Control

Methods Employed in the Plant of the American Multigraph Co., for Routing and Recording the Progress of the Work. Based on an Interview with R. G. Pack, Vice-president in Charge of Production, American Multigraph Co., Cleveland, Ohio

IT is a simple matter for the man who has charge of the work in a small shop to maintain close personal contact with each job and to ascertain that satisfactory progress is being made with its execution. This problem of supervision becomes increasingly difficult as the size of the plant increases, and in the case of large manufacturing establishments which are working on a product that involves the machining of a great diversity of parts, it would be impossible to attain and maintain the enormous production schedules which are required, without the use of carefully devised systems that enable the production manager to ascertain exactly what progress is being made with each part of the work.

In most lines of mechanical work, there is a very large number of parts to be produced for the assembly of each complete unit, and a shortage of any essential part would naturally hold up the production of the entire factory. It is to guard against such occurrences that the production manager must be kept constantly in touch with the progress that is being made in every step in the manufacture of each part, so that in the event of some unforeseen condition arising that would adversely affect production, steps may be taken at once to overcome the cause of the trouble. Practice varies as to the method of keeping the production manager informed in regard to the progress that is being made in the factory, and local conditions must always govern the method of procedure. However, as a general proposition, it may be stated that the system employed for this purpose should be worked out with the aim in view of attaining the maximum simplicity.

One frequently hears the term "production control" used by manufacturers and men employed in the production departments of industrial plants. As the expression signifies, production control is a means of assuring efficiency in the performance of manufacturing operations. Such being the case, an adequate system for the attainment of this result must go further than merely supervising the progress of work on various parts of each order that is going through the plant. It is also necessary to make sure that labor is being used efficiently and that there is not an excessive waste of material, due to the spoilage of work while it is in course of production; also, care must be taken to see that the labor cost that has to be charged against each job is not unduly high. Another important function of production control is to supervise the stock-room, with a view to making sure that there is always an adequate supply of all parts and supplies on hand to meet the requirements of the assembling department.

All of the requirements mentioned in the preceding paragraph are well looked after by a system of production control which is giving very satisfactory results at the plant of the American Multigraph Co. in Cleveland, Ohio. In addition to providing means of attaining the desired results, any system of this kind must be free from complications which would make it difficult for men in the shop to apply the system and which would consume a sufficiently large amount of time to interfere seriously with the production capacity of the plant. From the reader's standpoint, a most important feature is that this system is entirely general in its application, and could be successfully used in any machine shop engaged upon work where a considerable diversity of parts have to be machined for assembly into the final product.

Fig. 1. Route Book Open to show how Operation Tickets are bound Ready for Use in the Plant

How the System Works out

Fundamentally, the idea of this system of production control is to provide a simple and

absolute means of following the progress that is made in machining all parts of each order that is going through the plant. Incidentally, although this is also most important, the system provides for obtaining reports on the labor costs that must be charged against the work; it also calls for the recording of the number of parts which are spoiled while in course of production and the reason for this spoilage; instructions are given for routing work through the plant, so that there is a minimum amount of lost motion in transferring the pieces from department to department; and provision is made for handling successive operations in the most advantageous manner.

At the plant of the American Multigraph Co., several different types of multigraphing machines are built, and there is a large number of parts in each machine. Quotas covering a definite number of each machine are given to the assembling department for each month. Parts are issued to this department from stock carried by a finished stores department on receipt of assembling orders issued by the production department. Parts are processed in the factory in quantities to maintain a sufficient supply of parts in stock to meet the quota requirements set for the assembling department and to take care of all sales orders for parts. The producing of sub-assemblies, that is, machine members composed of a number of basic parts, which are assembled and sent to the stock-room as units, where they are held pending the time when they will be required in the assembling department, is another means of saving time and reducing production costs.

Method of Procedure in Executing an Order

When an order for the manufacture of a specified number of any type of multigraphing machines is to be issued to the factory, the first step is for a clerk in the production department office to make out what is known as a "route book," as shown in Fig. 1. It consists of a number of 3- by 5-inch operation tickets, which are bound into a cover in such a way that the tickets may be removed successively by tearing along a perforated line. A part number is assigned to each part of the product, which is composed of two numbers, one of which signifies the type of machine into which the part is to be assembled, while the other denotes the specific part of the machine in question. This duplex part number is entered on each of the operation tickets that is bound into the route book.

Each route book also carries a notation as to the number of pieces of this kind which is to be produced on the order, and a so-called "lot number," which is a serial number applied to the job in question for cost-keeping purposes. In making out a route book, the clerk who handles this work

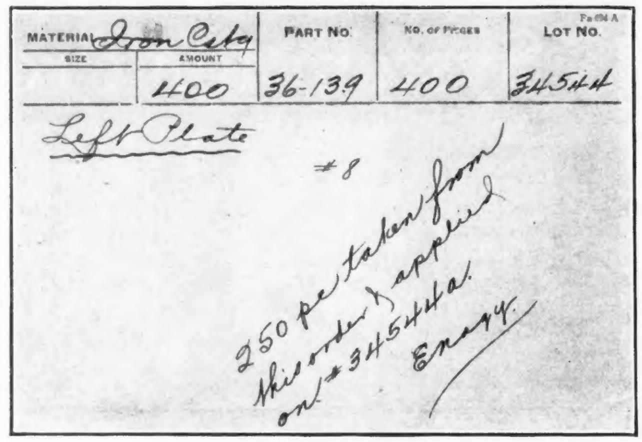


Fig. 3. Front Cover of the Route Book, giving Name of Part and Notation concerning Division of the Original Order

in the production department office has access to files of cards which are arranged numerically by part numbers, each card showing the complete sequence of operations required and the order in which they must be performed on the part in question, in order to complete it ready for assembling. With one of these master cards as a guide, the clerk proceeds to fill out a separate operation ticket for each department to which the work must be sent, with a statement of the operation which must be performed in that department. Fig. 5 shows one of these tickets. The part number and the lot number are entered on each of the tickets, and a notation of the number of pieces to be machined on the first ticket. At the bottom of each operation ticket bound in the route book, there is a numeral which represents the number of the department; and in the lower left-hand corner, spaces are provided for the foreman or the clerk of the department to enter the date on which he forwarded the work to the next department, and the number of the department to which the work was sent. The number of the department to which it must be sent is the number shown on the next operation ticket. The first sheet in the book, Fig. 4, is a requisition for material required from the finished stores department for executing the order.

Recording Parts Spoiled in the Process of Manufacture

In the event of one or more pieces having been spoiled during the performance of any operation, it is the duty of the clerk of the department in which the spoilage occurred to deduct from the number of pieces called for on the original order, the number which were spoiled. For instance, on the job for which the operation tickets are here reproduced, the original order called for 400 pieces, but in department No. 3 one piece was spoiled in performing operation No. 4, as shown in Fig. 5, so that under the heading "No. of Pieces" on the operation ticket for department No. 36 to which the work is sent, 399 appears in the space for recording the No. of Pieces instead of 400. The clerk in the department where the piece was spoiled must also make out what is known as a "scrap ticket," shown in Fig. 6, on which there is entered a complete record of the spoiled piece. This scrap ticket is made out in duplicate, one copy being forwarded to the production department office, while the other is sent to the salvage department with the work. It is the duty of one of the inspectors in this department to examine both the scrap ticket and the work, in order to ascertain whether the spoilage was due to carelessness or to an accident, and also to determine whether the defective piece can be salvaged or if its discard would be more profitable.

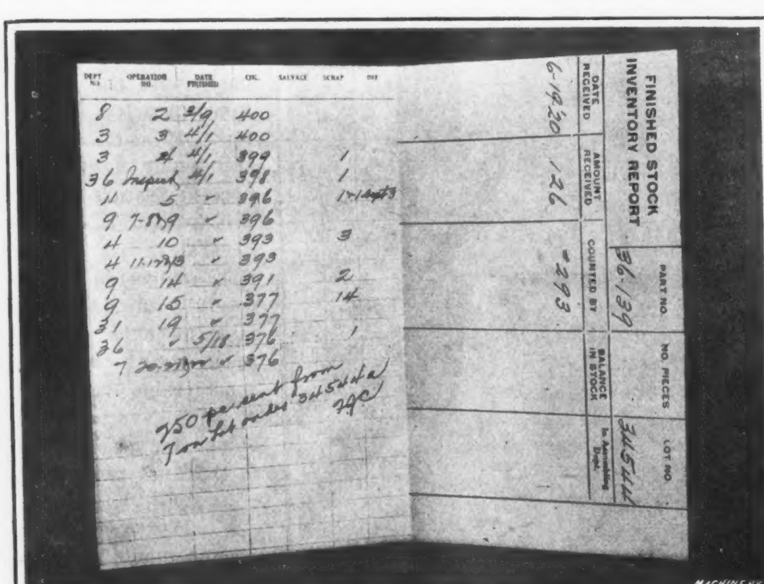


Fig. 2. Route Book with Operation Tickets removed to show Forms for Data recorded inside of the Front and Rear Covers

An effort is made to utilize as many of the defective pieces as possible, but owing to the dif-

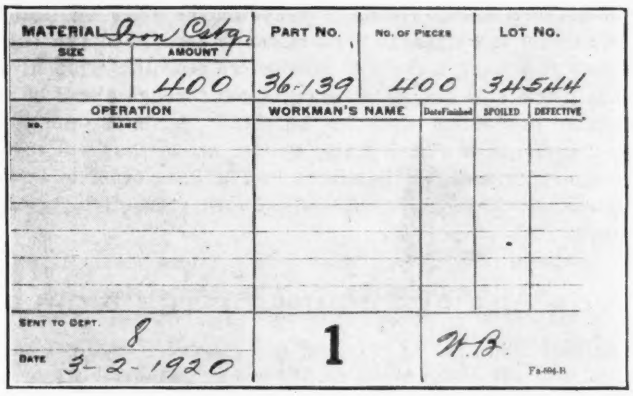

MATERIAL Iron Cstg.
SIZE AMOUNT 400
PART NO. 36-139
NO. OF PIECES 400
LOT NO. 34544
OPERATION NO. NAME
WORKMAN'S NAME
Date Finished SPOILED DEFECTIVE
SENT TO DEPT. 8
DATE 3-2-1920
1
W.B.
Fa-604-B

Fig. 4. Operation Ticket for Department No. 1. This is a Requisition on the Stock-room for the Necessary Castings

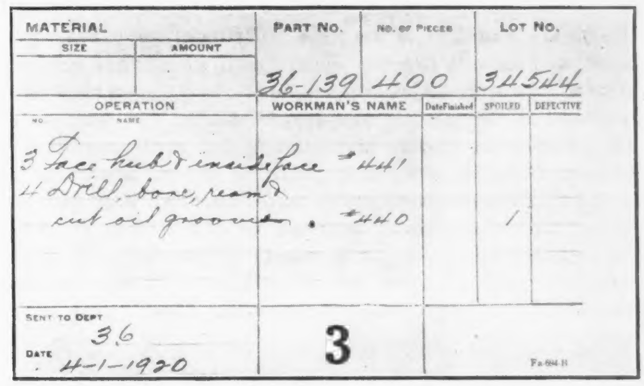

MATERIAL
SIZE AMOUNT
PART NO. 36-139
NO. OF PIECES 400
LOT NO. 34544
OPERATION NO. NAME
WORKMAN'S NAME
Date Finished SPOILED DEFECTIVE
3 Face hub & inside face #441
4 Drill, bore, ream & cut oil groove #440 1
SENT TO DEPT. 36
DATE 4-1-1920
3
Fa-604-B

Fig. 5. Operation Ticket for Work done in Department No. 3. One Piece was spoiled in performing the Fourth Operation

ficulty of successfully handling separate parts or merging them with other lots of regular production work, it is a moot question whether this department is a profitable one, except in so far as the supervision and effort to handle defective parts serves as a check to prevent an excessive number of pieces being damaged in course of production, because the foreman of a department which is showing too large an amount of spoiled pieces knows that he will be called upon for an explanation.

Reporting Progress of Work to the Production Manager

After each department of the factory finishes its work on a given lot of parts, the clerk of that department fills out the ticket that bears the number of his department, and this ticket is torn out of the route book along the perforated line and forwarded to the production department. When the proper notations have been entered on the next ticket in the book, both the partially finished pieces of work and the route book are sent on to the next department in which an operation will be performed. In this connection it is important to note that the route book is placed in a sheet-metal binder which serves to protect it from dirt and damage while passing through the plant. Before forwarding a route book and work, the clerk of the department which has just finished its operation on these pieces enters on a form printed inside of the front cover of the book, as shown in Fig. 2, the number of his department, the number of the operation which has been performed, and the date on which the work was finished, together with notations of the number of finished pieces that passed inspection and the number which were found defective. In this way one complete record of the job is kept with the work until such time as it is completed, and the operation tickets which are detached and forwarded to the production department serve as a duplicate record to be used in the follow-up system.

On the inside of the back cover of the route book, Fig. 2, a form is printed with spaces for entering the part number and lot number corresponding to similar notations on the tickets that are bound in the book; and below there are spaces for entering the date on which completed parts on this order were received in the finished stores department, the number of pieces so received, and the time clock number of the employe by whom they were counted. This route book cover is then sent to the production department where the number of pieces shown as received in the finished stores department is recorded on an inventory record card. This method of procedure constitutes a continual inventory of finished stock.

The operation tickets (Fig. 5) which are received by the production department as a lot is processed through the shop, and also scrap tickets (Fig. 6), are filed according to part numbers and lot numbers, the scrap tickets being placed in the same file with the operation tickets bearing the same part and lot number. By referring to this file, exact information as to the quantity, condition, and location of all work in process is easily and quickly obtainable; and when a route-book cover is received by the production department from the finished stores department, these operation tickets and scrap tickets are withdrawn from the files and checked against the record on the inside of the cover. The scrap tickets and cover are then sent to the cost department, the operation tickets being destroyed.

Recording Labor Charges against Each Job

In an introductory paragraph, reference was made to the importance of maintaining accurate records of labor costs that must be charged against each job. For this purpose production cost record tickets are used (see Fig. 8). These tickets are filled out by the foreman or department clerk, showing the part number, lot number, and operation number, as appearing on the operation ticket in the route book. Each employe is required to stamp one of these cards on a time recorder, to show the time at which he started and stopped work on each operation on which he was employed during the day. An exception to this practice of stamping in and out on each job is made in cases where operators are employed on a given job at the end of the day's work. In such cases, their punching out on the regular time-clock is regarded as evidence that they were employed on this job for which a new ticket will be stamped in on the time recorder

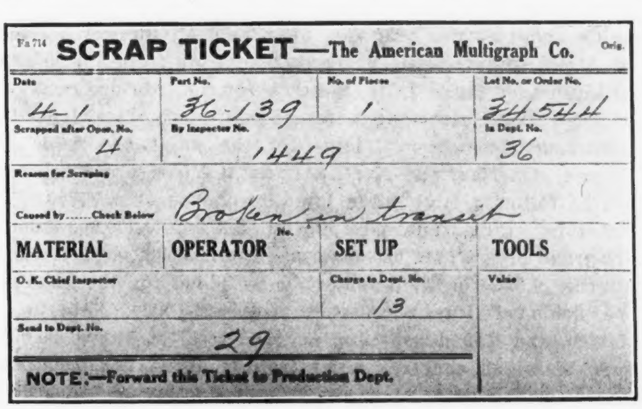

Fa 714 SCRAP TICKET—The American Multigraph Co. Orig.
Date 4-1
Part No. 36-139
No. of Pieces 1
Lot No. or Order No. 34544
Scrapped after Oper. No. 4
By Inspector No. 1449
In Dept. No. 36
Reason for Scraping
Caused by......Check Below Broken in transit
MATERIAL OPERATOR No. SET UP TOOLS
O. K. Chief Inspector
Charge to Dept. No. 13
Value
Send to Dept. No. 29
NOTE:—Forward this Ticket to Production Dept.

Fig. 6. Scrap Ticket, showing Result of Investigation conducted to ascertain Cause of spoiling One Piece in Department No. 3

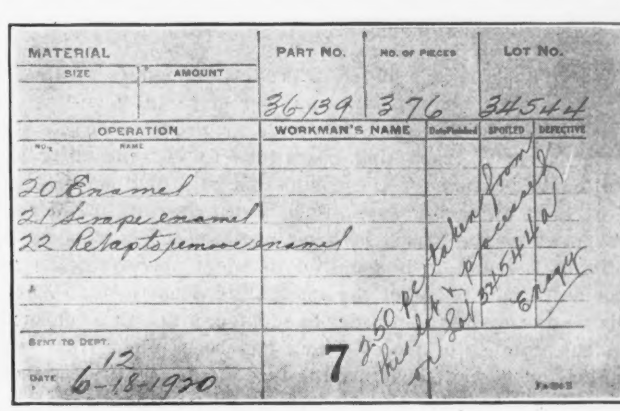
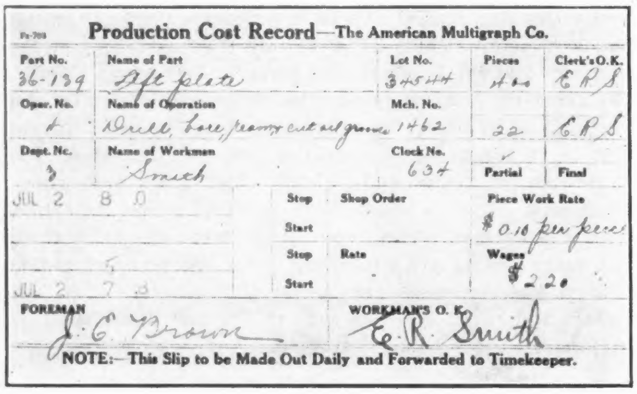

MATERIAL
SIZE AMOUNT
PART NO. 36-139
NO. OF PIECES 376
LOT NO. 34544
OPERATION NO. NAME
WORKMAN'S NAME
Date Finished SPOILED DEFECTIVE
20 Enamel
21 Scrape enamel
22 Retap to remove enamel
SENT TO DEPT. 12
DATE 6-18-1920
7
Fa-604-B

Fig. 7. Operation Ticket which carries a Notation concerning the Dividing of an Order to expedite Production

on the following morning. These production cost record tickets are sent first to the time department for payroll purposes, and then to the cost department, where they are segregated according to lot order numbers, and the labor is then recorded on the proper cost ledger sheet. The number of parts called for by the labor tickets for each operation is checked with the number of parts, as shown on the inside of the route-book cover, and if scrap has been produced the cost of the scrap parts is computed up to the point at which the spoilage occurred. As a result, an accurate cost is obtained of all O. K. parts and of scrap parts of each production order that is processed through the factory.

Maintenance of an Adequate Supply of all Necessary Parts in the Stock-room

In order for the production manager to so regulate manufacturing operations that there will always be on hand an adequate stock of all parts required in the assembling department, a careful analysis must be made of proposed production schedules for the forthcoming year, and of the requirements of the assembling department for all parts which are called for to produce the necessary number of finished units. It is also necessary to maintain in the stock-room a surplus of certain pieces for which there is a constant sale as parts; and the amount of this surplus varies according to the parts in question. A monthly report is sent to the production manager, which is arranged numerically by part numbers. This report shows the number of pieces of each part number that are on hand in finished stores and in process of production; and it also gives the order numbers of parts of each type that are in process, and the department in which each order is located. Finally, the monthly report shows the number of pieces of a given part number that are required to carry on operations according to schedule. With this record at his disposal, the production manager is able to quickly ascertain those parts for which there is urgent need, and he can then issue instructions to have special efforts made to expedite work so that their completion will be accomplished with the greatest possible dispatch.


Production Cost Record—The American Multigraph Co.

Part No.	Name of Part	Lot No.	Pieces	Clerk's O.K.
36-139	Aft plate	34544	400	E R S
Oper. No.	Name of Operation	Mch. No.		
4	Drill, bore, ream & cut oil groove	1462	22	E R S
Dept. No.	Name of Workman	Clock No.	✓	
3	Smith	634	Partial	Final

JUL 2 8 0 — Stop — Shop Order — Piece Work Rate
Start — $0.10 per piece
Stop — Rate — Wages
JUL 2 7 3 — Start — $2.20

FOREMAN J. C. Brown — WORKMAN'S O. K. E. R. Smith

NOTE:—This Slip to be Made Out Daily and Forwarded to Timekeeper.

Fig. 8. Production Cost Record Ticket used for recording the Labor to be charged against Each Job

Dividing Orders to Expedite Production

Where an order for pieces in process of manufacture calls for the production of a large number of parts, it will sometimes be found necessary to divide an order to enable the performance of machining operations to be sufficiently expedited to provide for the completion of a smaller number of parts at an earlier date. Such a procedure is found necessary where the supply of these parts in the stock-room is running low and it is required to adopt special means to provide for the needs of the assembling department. When this plan of dividing an order is adopted, a notation concerning the number of pieces which has been taken from the original lot is written across the face of the operation ticket in the route book for the department where this division of the original order was made. Fig. 7 illustrates such a ticket, where 250 pieces have been taken from the order and applied on a special lot No. 34544A. Appending the letter A after the lot number is a signal to the foremen of departments through which this work must still pass before reaching completion, that it is a rush job which must be put through ahead of all regular production work in the plant. A similar notation to that shown in Fig. 7 is also written across the front cover of the route book, as illustrated in Fig. 3, in order to avoid confusion which might otherwise result from dividing the order.

* * *

IRON ORE RESOURCES OF THE WORLD

Recent estimates of the iron ore resources of the world have been published in the United States Commerce Reports. It is stated that the available reserve supply in the Lake Superior district of the United States, in which four-fifths of the iron ore output of this country is produced, is 2,750,000,000 tons of an average grade of 52 per cent iron; the available reserves in the southeastern district, which includes Maryland, Virginia, Tennessee, Georgia, and Alabama, are estimated at 1,750,000,000 tons of 36 per cent grade phosphoric ore; and in the northeastern states, including New York, New Jersey, and Pennsylvania, the estimated reserves are 2,500,000,000 tons of an average grade of 35 per cent iron. Thus, the total estimate of iron ore in the United States is about 7,000,000,000 tons.

The total reserves of Canada have been estimated to be only 150,000,000 tons, but with a vast unexplored section, it is probable that large amounts still remain undiscovered. Newfoundland is credited with 3,635,000,000 tons of 50 per cent iron ore, and the estimated reserve for Cuba is 3,000,000,000 tons of a 36 per cent grade. One of the greatest ore reserves of the world, and certainly the greatest amount of ore suitable for the acid Bessemer process, is situated in the province of Minas Geraes, Brazil. The grade of the ore varies, but the average iron content is over 60 per cent, and the phosphorus is generally below the Bessemer limit. The total available reserves in the Minas Geraes field are estimated to be about 3,500,000,000 tons, while the entire resources of Brazil are estimated to be about 7,500,000,000 tons of 62 per cent grade.

On the opposite side of the earth, an estimate of 3,830,000,000 tons of iron ore is made for the United Kingdom. The ore in Spain averages about 47 per cent iron, and the estimate for that country is 650,000,000 tons. The total reserves of Sweden and Norway are estimated to be 1,470,000,000 tons, which has an average iron content of 54 per cent. The available ore in the field which covers a portion of Alsace-Lorraine, Luxemburg, and Belgium, is about 5,000,000,000 tons of a 30 per cent grade. The reserve estimated for France outside of that included in the field just mentioned, is about 200,000,000 tons, while that of Germany is about 1,300,000,000 tons.

Iron ore of various types is known to exist in South and West Africa, one deposit in French West Africa having recently been found to have a reserve of 100,000,000 tons, with an iron content of over 60 per cent. High-grade ores averaging about 50 per cent iron are found on the north coast of Africa, the reserves being estimated at from 100,000,000 to 150,000,000 tons. Little is known of the iron ore reserves of Australia, except that there are many important deposits.

Summarizing the estimates for the great ore fields of Europe, America, and North Africa, the iron ore resources are as follows: High-grade low phosphorus ores, 6,740,000,000 tons; high-grade phosphoric ores, 6,460,000,000 tons; low-grade ores, 17,100,000,000 tons; total, 30,300,000,000 tons. Another 1,500,000,000 tons should be added for the smaller ore fields of Russia, Austria, Greece, Chile, Venezuela, Mexico, and Canada, making a grand total of 31,800,000,000 tons, of which the equivalent iron is about 14,310,000,000 tons. On the basis of a pig iron production of 70,000,000 tons per year, the estimated quantity of iron ore in reserve is sufficient to last over two hundred years.

Curling Die Construction

By J. BINGHAM, President, The B. J. Stamping Co., Toledo, Ohio

THE punch and die illustrated in Fig. 1 is designed to flange out the bottom of a drinking cup shell and to curl or "wire" the top. This shell is made of tin and has a side seam like all common tinware. The flange enables the bottom of the drinking cup to be double-seamed on. The operation of the die is as follows: Punch *A* carries the curling ring *B*, which is made of tool steel and is hardened and ground. When the punch is in its upper position, the shell, shown in heavy lines, is slipped over the die ring *C*, which operates over the die-block and against spring action, when the punch descends. The amount of movement of this die ring is limited by screw *D*. Springs are placed under the die ring to help feed the shell down on the steel ring *E* by which the flange is formed. By making the springs stiff enough, the work is held up during the wiring operation, or until the pressure exerted by the punch is sufficient to overcome this spring action and press the shell down on ring *E*. All parts, except the tool-steel rings *B* and *E* and screw *D*, are made of cast iron. This construction is rather different from the usual design of dies employed on work of this kind.

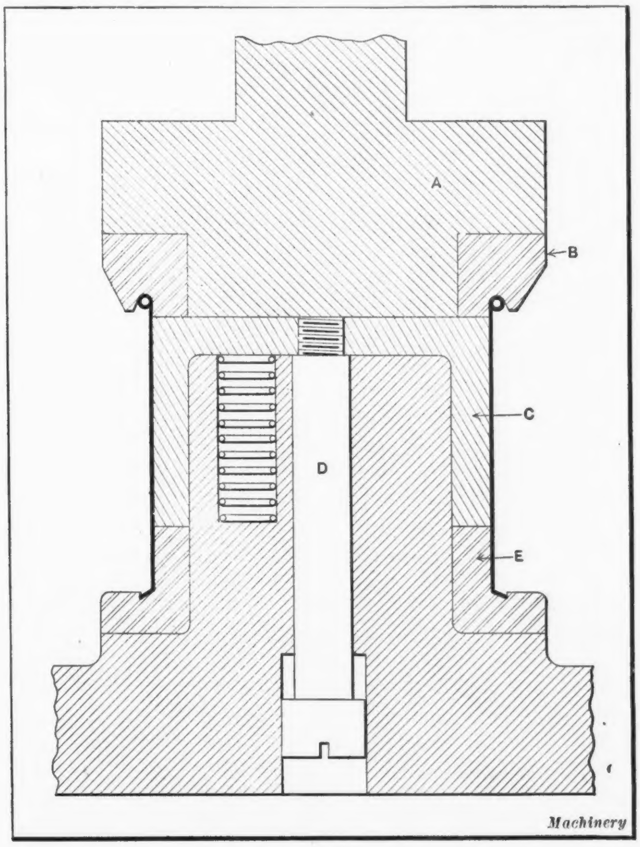


Fig. 1. Combination Curling and Flange-forming Die

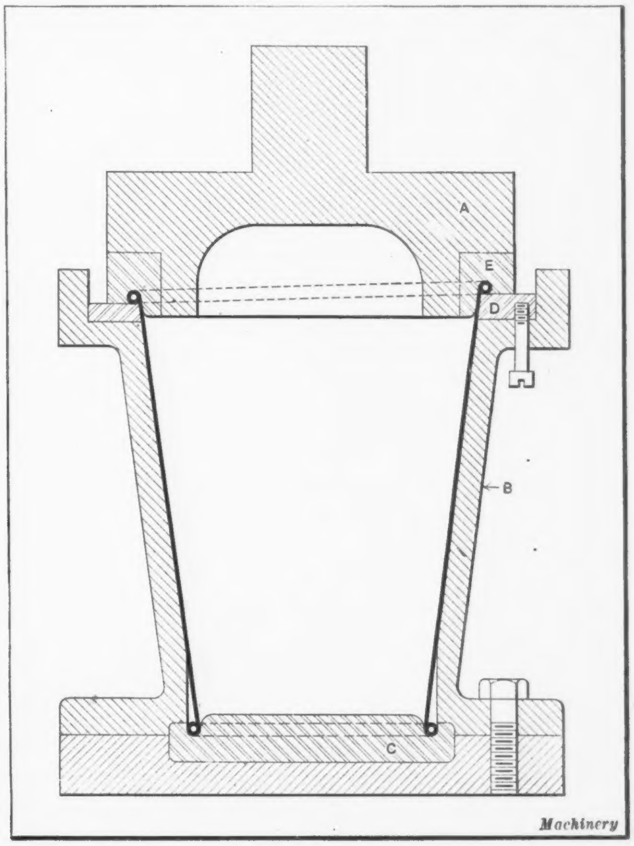


Fig. 2. Die for wiring Both Ends of a Tapered Tin Shell

Die for Wiring Both Ends of a Tin Shell

The tapered shell shown in heavy outline in Fig. 2 is wired at both ends in one operation by the punch and die illustrated. As the degree of taper is not great, the shell adheres to the sides of the die, and so an expansion punch is not required. Usually when work of this kind is done, the operation is performed on presses of special construction having a long stroke. In such cases side-arm presses are used, sometimes equipped with a sliding die that is mounted on ways on the bolster plate, and may be automatically operated to slide in and out by a mechanism provided under the press, or operated by hand.

The work is made of tin and is seamed. The shell rests in the die *B* with its lower end on the die-plate *C*, so that when punch *A* descends it will come in contact with the work and force it down until a curl of about three-fourths of a full circle is formed at the bottom. It will be noticed that the lower end of the inner surface of ring *B* has a clearance provided to permit the shell to be removed after the curling operation is completed. By the time the shell has been curled at the bottom so that it cannot be forced down any further, the wiring at the top of the shell takes place. The steel ring *D* at the top of the die serves the double purpose of supporting the wire ring during the curling operation and of ejecting the tapered shell from the die on the upward movement of the punch. This ring is operated by suitable springs (not shown in the illustration) so that as soon as the curling ring *E* has completed its work and punch *A* has started to ascend, the shell will be lifted from its seat in the die. The upper part of die *B* has a flange in which ring *D* is confined and by means of which it is guided in its movement.

Die for Forming and Wiring a Flange

The die illustrated in Fig. 3 is used for forming the flange on the cover of a bucket and for wiring this flange. As in the previous cases, the work is shown in heavy lines, and below the die will be seen the shell as formed in the first and second operations. In the first operation a combination die is employed, and in the second operation the top of the shell is cut out. The wiring dies receive the shell in the

latter condition and perform the operations in the following manner:

The flange is made of No. 20 gage sheet steel and is placed on the die, on which it is located by three guides *A*. The cast-iron punch *B* carries two tool-steel rings *C* and *D*, both of which are hardened and ground. Ring *C* is the forming member, and operates against springs carried in the punch, while ring *D* is set into the punch for the purpose of curling the formed flange. As the punch descends and the ring *C* comes into contact with the work, the latter becomes partly formed under the spring pressure, and while this is in process, the center guide pad *E*, which is attached to the punch by screws, enters the hole in the shell and acts as a guide while the wiring operation is being performed. At the extreme end of the downward stroke of the press ram, the rings *C* and *D* occupy the position illustrated, ring *C* completing the forming operation after the flange has been curled. On the return stroke of the ram, ring *C*, by reason of its spring action, will eject the shell from the punch on the die so that it may be readily removed. Die *F* is made of tool steel, hardened and ground, and the die-block to which it is welded, is made of wrought iron.

Die for Curling a Flat Band

The work which is curled in the die illustrated in Fig. 4 is a flat band or ring made of No. 16 gage sheet steel, rolled up and with the seam welded. This procedure was followed

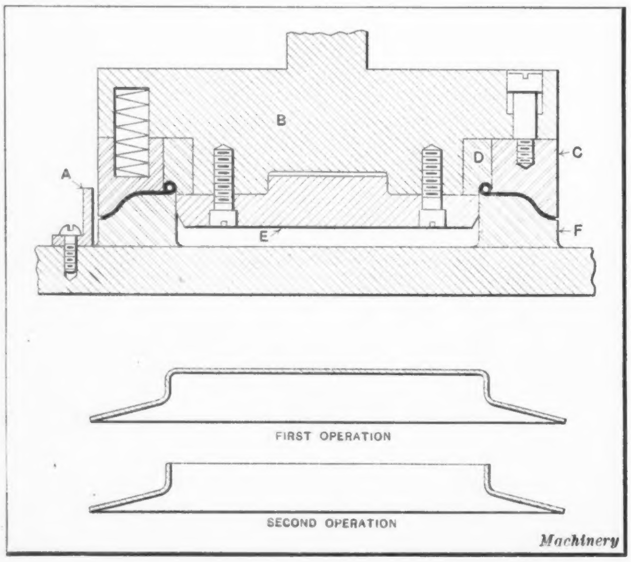


Fig. 3. Combination Forming and Wiring Die for Bucket Cover Flanges

to avoid drawing the shell and then cutting out the center, thereby saving considerable stock. With the dies open, that is, with the punch in its raised position, sufficient space is available so that the band may be placed in between the steel curling ring *A* and the cast-iron die *B*. There is a clearance of 0.01 inch between the band and the die, which is great enough to enable the work to be removed without much effort. The band fits snugly around the curling ring *A*, which is supported by the familiar rubber buffer construction, and is forced down on this ring during the curling operation by the tool-steel curling punch *C*, which is attached by screws to cast-iron punch *D*. After about one-fourth of this curling operation has been completed, screws *E* are brought to bear against the curling ring and push it down in the die. While the curling ring is being forced down, the remainder of the operation is in process so that the metal is curled back to the required depth, in this case ½ inch. As the punch ascends, ring *A* returns to its proper position by reason of the rubber buffer attachment, so that the curled ring may be lifted from the die, which can be easily accomplished because the metal springs sufficiently not to adhere to the ring. The clearance between the work and the interior of the die provides for this condition.

MAGNESIUM ALLOY FOR MOTOR PISTONS

A new alloy consisting of 90 per cent magnesium is the lightest known metal adapted for commercial uses, according to an article by George Gaulois in the *Scientific American*. This alloy, which is called Dow metal, is one-quarter the weight of cast iron and one-third lighter than aluminum. The main use found for it thus far has been in the manufacture of pistons for automobiles, airplanes, and motor boats. It possesses a tensile strength ranging from 22,000 to 25,000 pounds per square inch, has no abrasive or scoring action on cast-iron cylinders, and has approximately the same coefficient of expansion as other light piston alloys. The difference between this metal and aluminum, as far as expanding under heat in a motor is concerned, is that the magnesium alloy has no permanent growth or set at these high temperatures. Recent tests have shown that with twenty-one successive heats made for two hours each, at temperatures up to 800 degrees F., the permanent growth is so minute that it cannot be detected with a micrometer.

In machining the metal, no cutting compound is necessary. Great resiliency is shown by a recent test in which a piston was placed in a vise and contracted ¼ inch. Upon being released from the vise, the piston returned to the original size, the only difference being that it was about 0.004 inch out of round. The important physical properties

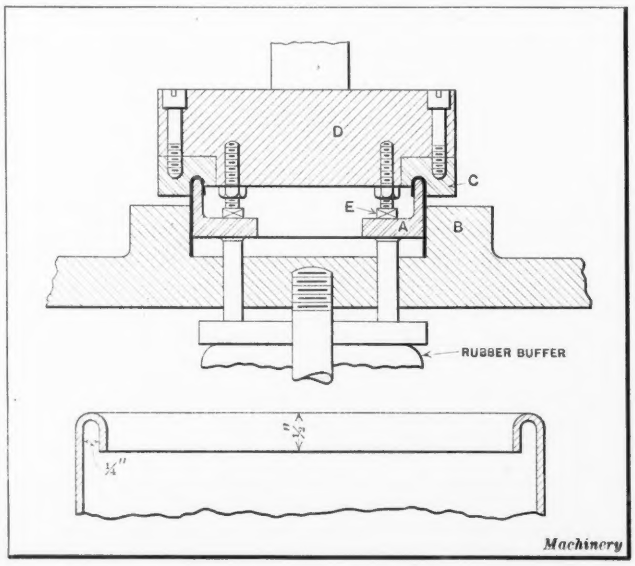


Fig. 4. Dies used for curling a Seamed Flat Band or Ring

of the alloy are as follows: Specific gravity, 1.79; tensile strength, 22,000 to 25,000 pounds per square inch; yield point, 12,000 to 14,000 pounds per square inch; compressive strength, 45,000 pounds per square inch; elongation on a two-inch test piece, 3.5 per cent; reduction in area, 3.5 per cent; modulus of elasticity, 9,000,000; and Brinell hardness 55 to 75.

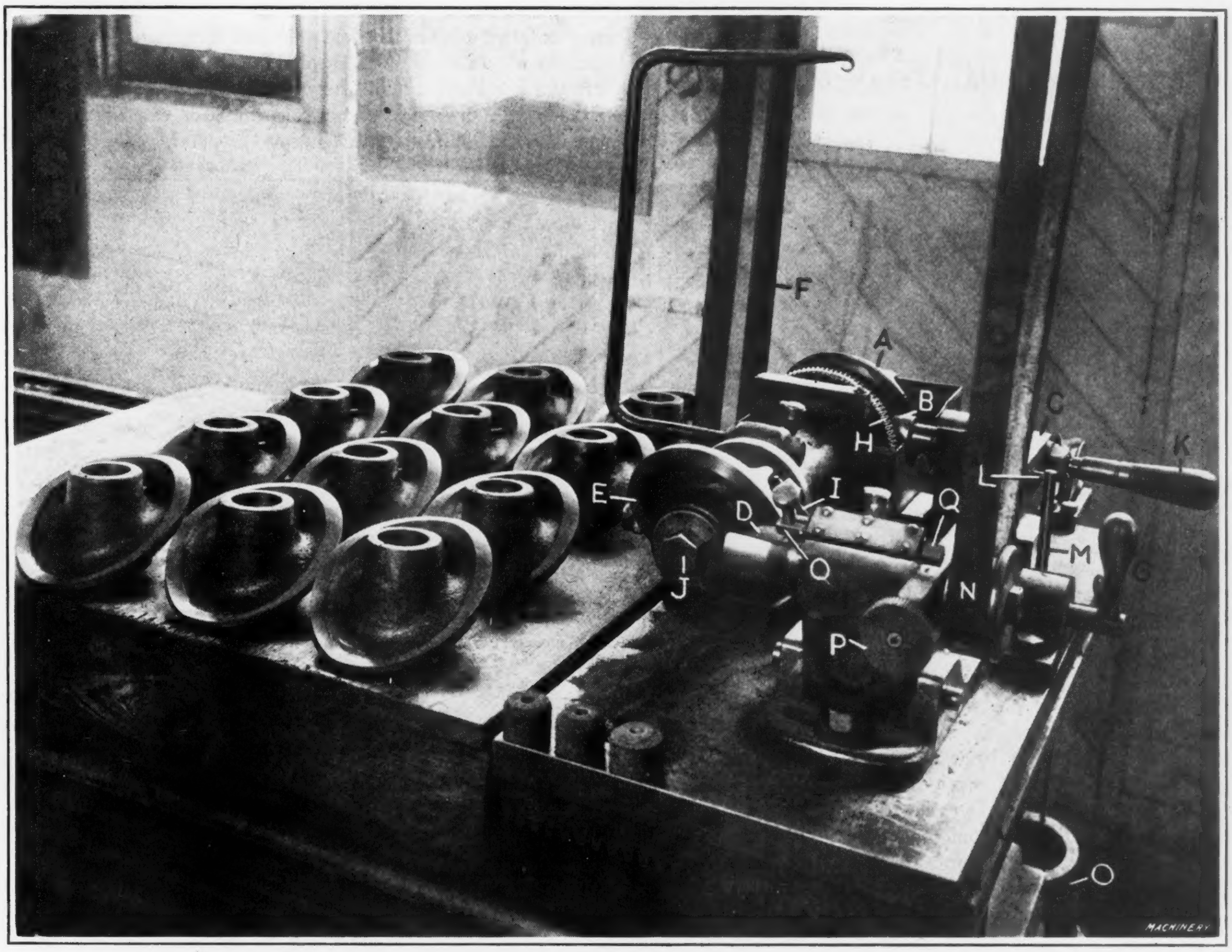
When the metal is reworked or rolled, drawn, drop-forged, or heat-treated, the tensile strength is increased by each operation. In heat-treating sand castings, the tensile strength is increased from 22,000 to 30,000 pounds per square inch without causing any appreciable change in the yield point, while the elongation and reduction in area are increased 6 per cent. In drop-forging, the tensile strength is increased to 50,000 pounds per square inch and the Brinell hardness rises to 70 or higher. An actual test of a piston made from this metal is being conducted in a light roadster, the piston having now been in constant service for over a year, during which time the automobile has traveled over 20,000 miles. This piston is still giving good service. Another test in the plant of a motor manufacturer showed that motors developed six horsepower more with the pistons made from this alloy than had been developed with any other material.

Grinding Shaper Cross-feed Cams

IN the automatic cross-feed mechanism of shapers built by the Queen City Machine Tool Co., Cincinnati, Ohio, a cam is used which is of the form shown at the left-hand side of the accompanying illustration. The illustration also shows a special grinding machine that affords a simple and rapid method of grinding the track on these cams. The principle governing its operation is that of having a master cam of the required form, which rotates in unison with the work and adjusts the position of the wheel so that the work is ground to the required contour.

In working out the details of the mechanism of this machine, provision was made for obtaining the operating conditions outlined in the preceding paragraph by the following means: Master cam *A* has a roller *B* running in contact with it; this roller is carried on a pivoted head that is secured to one end of a link *C*, which oscillates the grinding wheel *D*, the latter being carried by a similar pivoted head secured to the opposite end of link *C*. Wheel *D* grinds cam *E*. Master cam *A* and cam *E* to be ground are mounted at opposite ends of the same shaft, and they are rotated in unison by means of belt *F*. Lever *G* at the operating side of the machine provides for the engagement or disengagement of a positive-jawed clutch on the driving pulley that carries belt *F*; and the power is transmitted from this pulley through a worm and worm-wheel *H*, which reduce the speed of rotation of the master cam and the work to six revolutions per minute.

Cam *E* to be ground is first bored and faced in a Jones & Lamson flat turret lathe, equipped with a special chuck, care being taken to maintain the cam track in an accurate position. This assures performing the grinding operation in a minimum length of time. Cam *E* is slipped on the nose of the special grinding machine spindle, and its position is then adjusted by means of a thumb-screw *I*, which bears against a rib on the back of the cam, the purpose being to locate the cam that is to be ground in a position corresponding exactly with the position of the master cam *A* on the spindle by which these two pieces are carried. After this adjustment of the position of the work has been accomplished, the cam is clamped in place by means of a bolt *J*.



Special Machine used for grinding Cams for the Automatic Cross-feed Mechanism of Queen City Shapers

Hand-lever *K* makes it possible for the operator to pull both the cam-roller *B* and the grinding wheel *D* out of contact with the master cam and the work, respectively; carried on link *C* there is a pin *L*, so that when it is desired to hold the grinding wheel and cam-roller out of contact with the work and the master cam, a pin *M* carried on a sliding member can be pushed into place behind pin *L* while in its forward position, thus keeping these two pairs of contacting members disengaged. The ball-bearing grinding wheel spindle is driven at a speed of 12,000 revolutions per minute by means of an independent belt *N*. The pressure of the grinding wheel against the work, and of the roller *B* in contact with master cam *A*, is maintained by a weight *O* that is attached to the link *C* by means of a cable.

Grinding wheel D is fed to the work by a screw operated automatically through a mechanism of which ratchet wheel P is a part, that provides for shortening the distance between the points of connection of the oscillating heads (carrying grinding wheel D and cam-roller B) with the link C. Carried on the grinding wheel head, there is a diamond wheel truing device Q which is always available for use in dressing the grinding wheel. After a smooth surface has been obtained on the work and before removing it from the machine, the wheel is trued, after which a final finish-grinding operation is performed, that assures obtaining an accurate bearing between the track on the cam and the roller that runs in contact with it, when assembled in the automatic cross-feed mechanism of the Queen City shaper. Attention is also called to the fact that normally there are guards covering the master cam A and the worm-wheel H, and the grinding wheel D and the work E, as well as other running members of the mechanism; but these guards were temporarily removed, in order to more clearly illustrate the arrangement of the mechanism. This machine is of simple and compact design, and performs the cam grinding operation in about sixteen minutes.

* * *

ECONOMICAL USE OF COAL

Coal conservation by the use of the most modern appliances was urged by the director of the United States Geological Survey in a recent address. It was pointed out that the small steam plant by necessity wastes an enormous amount of the coal that is being burned, because of the impossibility of recovering more than a small percentage in actual power. The large electric generating station using modern steam turbine equipment is able to reduce this waste by a large percentage, simply because more modern appliances and bigger power units are employed. It has often been predicted that some time in the future large central power plants will be located at the coal mines, the fuel being burned directly without transportation, and electric current instead of coal being carried from these points to the industrial centers where power is required. It is obvious that in this way a twofold saving would be accomplished: First, the enormous amount of power now used merely for transporting coal would be saved; and second, the large power units possible in central stations located at the mines would be able to produce power very cheaply.

* * *

The Holt Mfg. Co. of Stockton, Cal., says *Safety Engineering*, has posted a bulletin throughout the plant, pointing out to the employes what fire losses mean economically to every individual. According to this bulletin the per capita fire loss in the United States is \$3.13 annually, as compared with 61 cents in England, and 49 cents in France.

OXY-ACETYLENE WELDED CONSTRUCTION OF GASOLINE PLANT

A new casing-head gasoline plant erected recently for the Charles F. Noble Oil & Gas Co., at Burk-Burnett, Texas, by the L. D. Gunn Co., Wichita Falls, Texas is of interest because of the fact that all-welded construction is employed throughout the plant. Ordinarily this class of work would require threaded pipe, but the difficulty of obtaining this material was a serious obstacle in this instance, whereas plain-end pipe could be bought for immediate delivery and at a considerably lower cost. The previous successful experience of the Gunn Co. in using the oxy-acetylene welding process in the Oklahoma and Texas oil fields convinced the operators that a thoroughly satisfactory system, which would stand up under severe pressure test, could be constructed by welding the joints of tanks, pressure separators, etc., as well as the joints of pipe lines.

In the foreground of Fig. 1, are shown two absorption towers of all-welded construction, while in the background are shown the welders at work on a similar tower. From this illustration it will be seen that the seams or joints on the finished towers are smooth and have a substantial appearance. The casing-head gasoline tank shown in the foreground of Fig. 2, and the line of casing-head absorption towers at the rear are good examples of the heavy welded construction employed throughout the plant. In putting up pipe lines, it was found feasible to weld where special pipe fittings would ordinarily be required. It was found that right-angle turns, T-connections, and reducers, could be easily made up. By using the oxy-acetylene flame the pipe could not only be welded but could also be cut to the required length, both operations being performed by one welder.

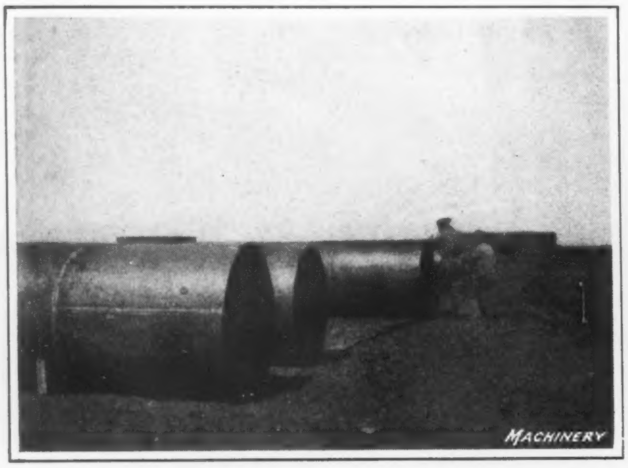


Fig. 1. Absorption Towers being welded by the Oxy-acetylene Process

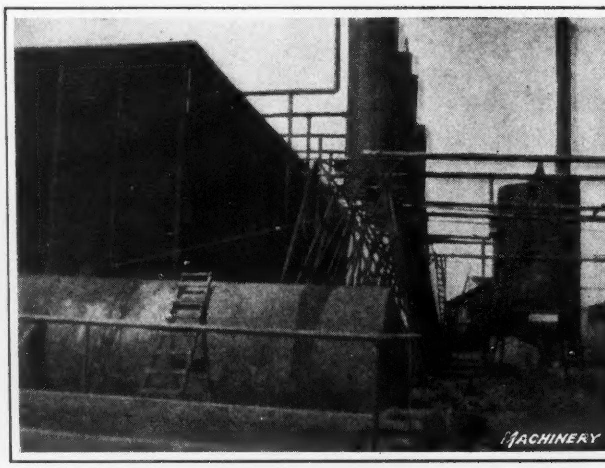


Fig. 2. Gasoline Absorption Towers and Pipe Lines of Welded Construction

* * *

INTERNATIONAL AGREEMENT ON WAR-TIME PATENTS

An international agreement concerning the preservation or re-establishment of patent rights and property rights in designs and trademarks affected by the war has, according to *Engineering*, been signed and ratified by Great Britain, France, Germany, Poland, Sweden, Switzerland, Tunis, Czecho-Slovakia, the Netherlands, and Portugal. The arrangement provides for extensions of time for filing applications under the International Convention for the protection of industrial property, and also for extensions of time for accomplishing any act, fulfilling any formality, paying any fees, and generally satisfying any obligation prescribed by the laws or the regulations of the signatory states. The new arrangement gives the patentees the right to apply for a patent or pay an overdue tax, in cases where they had been unable to take the necessary action owing to circumstances arising out of the war.

Molding a Deep Cast-iron Hopper

By M. E. DUGGAN

THIS description concerns the molding of a deep cast-iron hopper used for receiving ashes deposited from steam boilers. These hoppers, or ash receivers, have caused much trouble both in their production in the foundry and when subsequently used under the boilers. The trouble experienced in the foundry started with the design of the part in the drafting-room.

Referring to Fig. 1, it will be noted that the hopper is wide, and quite deep through the V-section, and that the sides are parallel. The interpretation of the drawing by the patternmaker led to the making of the pattern without draft, to be molded in green sand. It was intended that the inside of the mold be lifted with the cope, the outside of the pattern being located in the drag side of the mold. It will at once be apparent that the patternmaker should have provided the customary draft, particularly in view of the depth of the casting and the method of molding. It was extremely difficult to lift the heavy body of sand out of the inside of the pattern or to withdraw the pattern from the drag, a fact which naturally reflected on the judgment of the patternmaker. When making the mold in the regular way with this pattern, a great deal of trouble was experienced in lifting the cope, because the sand on the side of the mold was sheared away. The same difficulty was also experienced in withdrawing the pattern from the drag half of the mold, which necessitated that the disturbed part of the mold be mended and slicked over.

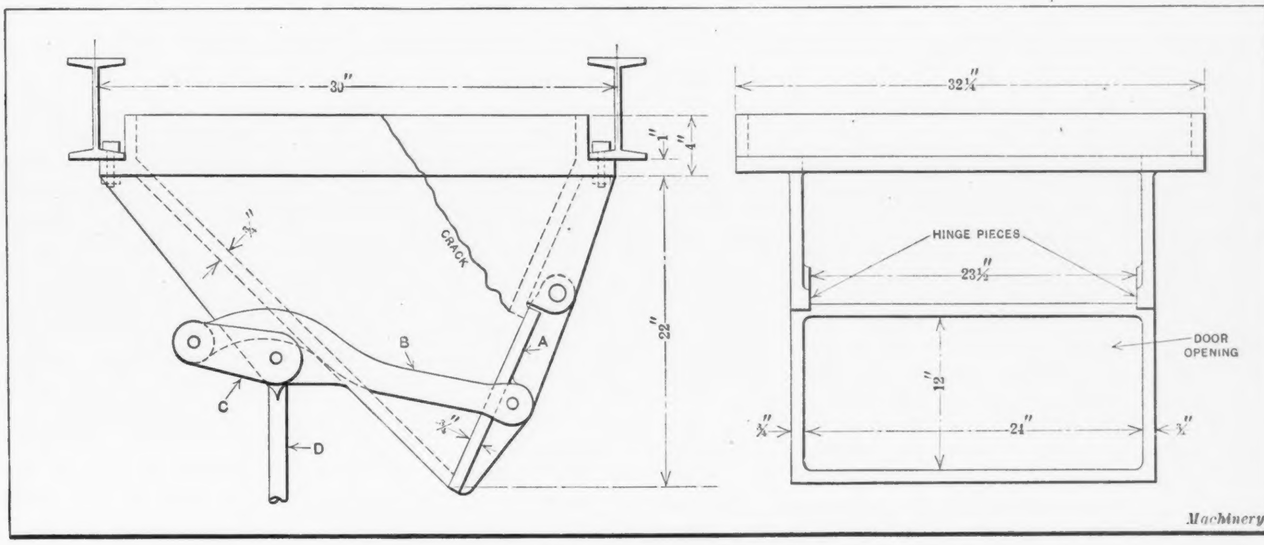


Fig. 1. View of Cast-iron Hopper showing how Inefficient Foundry Methods resulted in Failure in Service

Before considering the effect of thus repairing the mold on the quality and service of the casting, it will be well to refer to the design of the hopper itself, as indicated in Fig. 1. It will be seen that the thickness of the metal is ¾ inch, the depth 26 inches, and the width 25½ inches on the main body and 32¼ inches on the upper portion. The weight of this shell should be approximately 600 pounds, but the shearing away of the sand in making the mold and the subsequent mending and slicking resulted in an uneven increase in the thickness of the wall varying from 1 inch to 1⅜ inches. It will be readily seen that this added materially to the weight of the casting, the actual weight being 775 pounds, or 175 pounds greater than was intended.

This increase in weight is objectionable, especially since it is unevenly distributed. In this connection, it is well to consider the kind of service that is required of the hopper. The casting is fastened with bolts to I-beams in the boiler-room floor (see Fig. 1). A door *A* covers the discharge opening in the hopper, and is operated by lever *B*, bellcrank *C*, and lever *D*, one such mechanism being provided on each side of the hopper. The hot ash falling into and remaining for some time in the hopper produces sufficient heat to cause the uneven walls to become red-hot in spots. The resulting expansion and distortion, augmented by the weight of the ash and of the casting, exerts a severe strain on the locking levers *B*, which is very likely to result in the hopper becoming cracked in its weakest section. A logical place to expect such a fracture is in the vicinity of the door hinge, as indicated. Sometimes this crack is large enough so that when the door is released an entire section of the casting will drop away. It will thus be seen that either through the failure of the draftsman to indicate the methods of molding properly, or through the patternmaker's error of judgment, a serious condition resulted which might easily have been prevented.

The molding problem is one which must always be handled wisely and with due consideration for the cost factor. It might even be wise to produce the casting here described and illustrated, as it actually was produced, if there were only two or possibly three castings to be made, but a great deal more labor and care would be required in molding than would otherwise be necessary and the product would at the same time be inferior. When a number of castings are to be made, as in the present case, however, the matters of design and production should be considered, and the most efficient molding scheme should then be followed.

In this connection, it is well to consider how the casting was produced in a certain foundry where an order for forty had been received. The pattern was changed to give a 2-inch draft on the sides, and provision was made for using a dry sand core in place of the green sand formerly used. A sectional view of the mold is shown in Fig. 2 from which it will be seen that the upper part is molded in the cope and that the mold is parted so as to bring the core entirely in the drag. A new pattern was, of course, required as well as a core-box. Attention is directed to the method of setting the core. It will be seen that the new pattern provides a

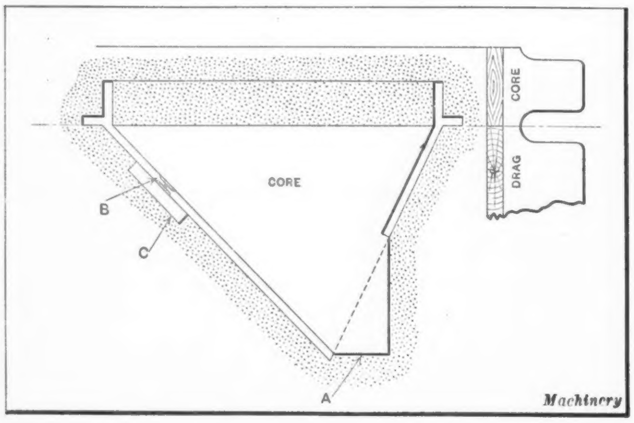


Fig. 2. Cross-section of Hopper Casting Mold using Dry Sand Core with Special Supporting Provision

foot-rest for the core. This is rather an unusual idea and is made possible by the door opening in the wall of the casting. The back of the core is supported by stud chaplets *B*, which rest on a slab core *C*. This slab core is rammed up with the mold and furnishes a substantial seat for supporting the weight of the core.

This method of molding is much quicker than the method previously mentioned, and the product is much more accurate and uniform; consequently the weight is correct. The advantage of predetermining the method of procedure in molding propositions such as this is forcefully shown in the present case.

* * *

GRINDING A KEYWAY GAGE FOR A TAPERED HOLE

By J. B. GRAY

The accompanying illustration shows a gage which is required to be replaced frequently, and which presents a rather unusual grinding problem, due to the fact that the dimensions as given in the illustration must be accurately maintained. It is especially desirable that the two radius dimensions, 0.623 inch and 0.750 inch be correct, and it is important that a means be provided whereby these dimensions can be easily tested or checked from time to time by the inspector. The keyway gage is used to gage the distance from one side of a tapered hole to the bottom of a keyway diametrically opposite, within a tolerance of 0.002 inch. Were it not for the 1/8-inch dimension which represents the depth of the keyway, the nominal diameter of the gage at the large end would be 1 1/4 inches. Allowing 0.004 inch for a drive fit, the diameter of the "Go" gage at the large end would be 1.246 inches, and the large end of the "Not Go" gage would be 1.250 inches in diameter. One-half of the "Go" gage has a dimension of 0.623 inch, as shown in the illustration. The radius dimension of the other half of the gage, including the depth of the keyway, is 0.750 inch.

Surface *A* represents the "Not Go" or full size step, while step *B* represents the "Go" or minimum dimension. Therefore, if the face of the work lies between these two steps, when the gage is inserted in the hole, it is known that the work is within the required limits of accuracy. A collar *C* provided with a handle *E*, as shown by the dotted lines, is secured to the handle of the gage by the set-screw *D*, and is used to rock the gage when grinding the taper on the short side.

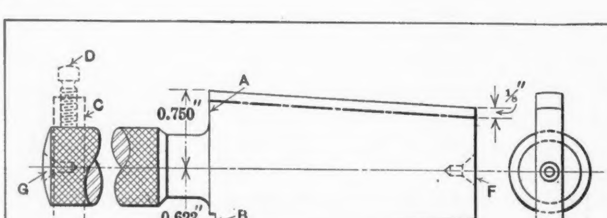
In making the gage, the first thing to consider is the production of centers at *F* and *G*. These centers must be smooth and true, and should be lapped before the gage is ground. A stop-collar should be placed on the drill when drilling the centers in order to keep them a uniform depth. The stock from which the gage is to be made, and also two auxiliary full-round pieces of stock of the same length and diameter should be centered as described.

Both the gage and the auxiliary pieces which are to be used in connection with the production of the gage, are hardened after the preliminary machining operations. The centers are next lapped, after which one of the auxiliary pieces is placed in the grinder. This piece is first ground straight and a facing cut taken over one end, in order to obtain a true surface that can be used in setting the machine to grind the required taper. Then the piece is taper-ground to nearly 1.500 inches at the larger end, after which the grinding wheel is carefully trued up, and the blank is finish-ground to the exact dimension, thus obtaining the radius 0.750 inch as indicated in the illustration.

After the grinder stop is set to this size, or the setting of the machine is noted, the blank is removed and replaced by the piece from which the gage is to be made. This piece is then ground down to the correct size, being rotated on centers, and a stop, or the graduations on the cross-feed handwheel employed to determine when the work is the required size. Next the gage and the auxiliary piece are compared by placing them in a lathe or some other machine, the centers of which have been carefully ground and tested. A dial indicator is used in making the comparison, and it will, of course, be found that the gage is still somewhat larger than the auxiliary piece, owing to the slight wear on the wheel which takes place after making the initial setting of the machine. As the indicator shows the amount of difference between the gage and the piece, it is a simple matter to replace the gage in the grinder and remove the amount of material required to bring it down to the same size as the auxiliary piece. It may be necessary to make several comparisons and take several light finishing cuts before this is accomplished.

As the side of the gage having the shorter radius cannot be ground by rotating the work, a somewhat different procedure is necessary. In grinding this side, the other auxiliary piece is ground until it measures 1.246 inches at the large end, or twice the amount of the radius, 0.623 inch, indicated in the illustration. The stop on the machine is set at this position, as in the case of the previous grinding operation, and the gage placed in the grinder. After backing out the wheel—or the work, as the case may be—the traverse feed is engaged and the work rocked by operating rod *E* with the hand, until the gage is ground down to size. The testing or comparison between the auxiliary piece and the gage is the same as that employed in grinding the gage to the 0.750-inch dimension. By keeping the two auxiliary pieces for permanent reference, the gage can be duplicated at any time, or one auxiliary piece may be used, and ground first to the larger size, and then to the smaller size; when, however, many of these keyway gages are used, two test pieces will prove advisable.

The method by which this gage was produced may be used to advantage by others having similar gage-making problems. The method of comparing the work with a full round test-piece insures accuracy and eliminates the chance for errors which are likely to occur when only the graduations on the feed-screw of the grinder are relied upon to determine the size. Another advantage of this method is that it produces a gage which can be easily checked for accuracy by the inspector.



Gage for gaging Depth of Keyway in Tapered Hole

New Precision Measuring Device

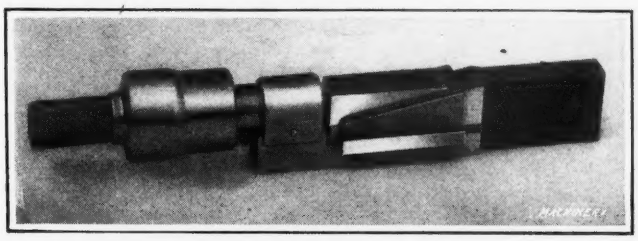


Fig. 1. Hanson Precision Measuring Device with Upright and Sliding Head removed, showing Tapered Wedge

A NEW precision measuring device which makes it possible to measure accurately to within a hundred-thousandth part of an inch by the use of only six precision measuring blocks has been designed by B. M. W. Hanson of Hartford, Conn. With this device a complete set of precision blocks becomes unnecessary, and measurements can be obtained more rapidly than by picking out a large number of blocks in order to obtain the desired combination. The device, as shown in the accompanying illustrations, Figs. 1 and 2, consists of a base in which is mounted a taper wedge actuated by a micrometer screw, and an upright. The graduated thimble of the micrometer screw is of larger diameter than on an ordinary micrometer, so that graduations indicating 0.0001 inch are approximately 1/16 inch apart, making it possible, by means of a vernier, to read variations to 0.00001 inch.

It will be seen by referring to the illustrations that the taper wedge, which is an accurately lapped block sliding upon a lapped surface on the base, may be moved forward by the micrometer screw. The angle on the taper block is so selected that as the micrometer screw moves forward one-thousandth inch, the top of the block is raised two ten-thousandths inch, and in this way very small variations in dimensions may be detected.

The device is provided with an upright, attached at the lower end to the base block, which it straddles. In the slot in the center of the upright slides a head which is used for holding and binding the upper measuring bar in any desired position; thus it is evident that when the upper measuring bar is in place, the device may be used much in the same way as a micrometer, except that it will measure with much greater accuracy. Two binding screws are provided for the sliding head; one merely provides for a good sliding fit of the head when the instrument is in use, while the other is a positive binding screw that will bind the head to the upright in any given position.

The device, as shown in the illustrations, has a measuring capacity or range from 0 to 3.200 inches, and may be employed to measure accurately any dimension within this range by the use of six Johansson measuring blocks—two 1 inch; one ½ inch; one 0.300, one 0.200, and one 0.100 inch. As the taper wedge has a lateral movement of ½ inch, its top surface has a vertical movement of 0.1 inch, so that any dimensions between 0 and 0.1 inch may be measured without an additional block. An advantage of the instrument is that it is practicable to measure extremely thin parts with it. If the movable top jaw is placed directly on the wedge, measurements beginning with 0 may be taken.

Use of the Device for Measuring Work

It is clear that when the device is to be used for measuring, the thimble is set at 0, when the top surface of the wedge and of the lower or fixed measuring jaw will be level. Then the approximate size to be measured is built up with precision blocks placed between the wedge and the upper or movable jaw, as shown in Fig. 2. The sliding head is next brought down upon the movable jaw and the horizontal clamping screw is tightened, which holds the blocks and the jaw firmly in place but still permits them and the head to slide within the upright when the taper wedge is actuated by a movement of the micrometer screw. As the size between the two jaws is now accurately known when the micrometer reads 0, it will be clearly seen that the accurate dimension of the piece to be measured may be determined by actuating the micrometer screw and thereby moving the upper measuring jaw as required.

It is evident that when a measurement is to be taken of an unknown size, it would be very difficult to obtain the measurement by the use of precision blocks alone, as the user cannot guess what combination of blocks he needs in order to make a comparison with his unknown measurement. With the device described, the user picks out blocks to make up the approximate size, and then obtains his final measurement by the adjustment of the wedge until the jaws fit over the piece being measured.

Using the Device as a Height Gage

The device may be used for obtaining the height from one surface to another, as for example in planer work or surface grinding. The height wanted is built up with a combination of the wedge and the blocks, and the planer tool may be readily set to the exact dimension required; or, if it is desired to determine the exact dimension from one planed surface to another, it is only necessary to place a parallel on the top of the upper surface, place the instrument on the lower surface, fill it with blocks until nearly the correct dimension has been obtained, and then actuate the wedge by the micrometer screw until the instrument with its blocks fits between the lower surface and the parallel resting on the upper surface. The dimension may then be read off directly from the barrel of the micrometer screw. The upper jaw may protrude beyond the lower jaw if required, and in this way the distances from one surface to another may also be easily measured. By making the end of the upper jaw into a sharp edge, so that the lower surface

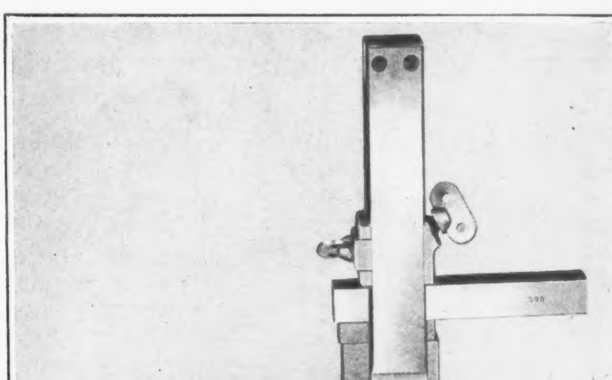


Fig. 2. Precision Measuring Device with Upright in Position Ready for taking Measurements

of the upper jaw ends in a sharp point, this point may be used for accurately scratching lines for accurate machining.

Practical Application of the Measuring Device

One of the main features in connection with the design of this measuring device is that it is intended to be a practicable measuring tool for shop use and not an instrument for laboratory application. While the instrument will measure to one-hundred-thousandth inch as accurately as any other instrument adapted for shop use, mechanics know that it is seldom or ever that it is necessary to measure to any such accuracy in shop work, and the fact that the instrument will measure with ease to an accuracy of a ten-thousandth part of an inch is really what commends it for general use.

Adjustment for Wear

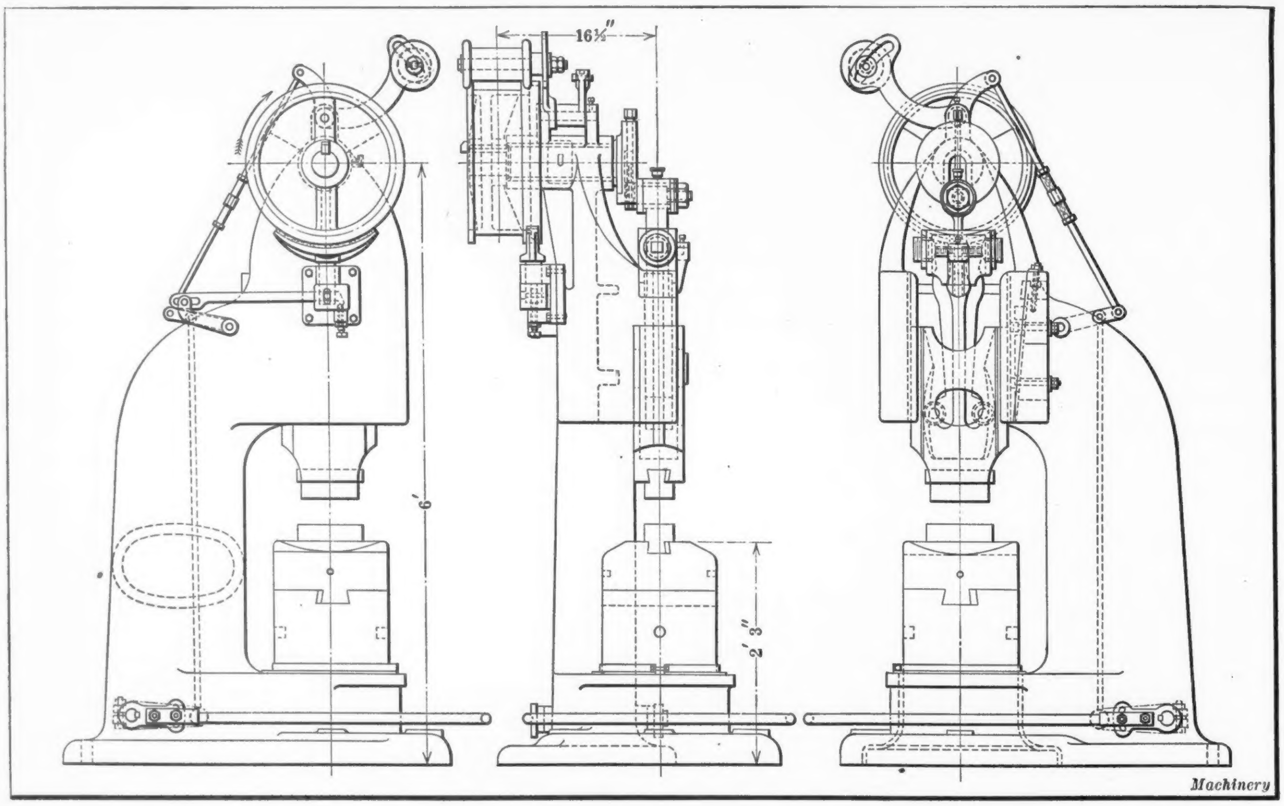
When after long use any wear occurs that affects the accuracy of the instrument, such wear may be easily compensated for. The amount of wear is detected by using for comparison a set of Johansson gages or a reliable measuring machine. The wedge is placed in a number of different positions, and measurements are taken from the top surface of the wedge to the bottom surface of the lower jaw, these measurements being compared with the graduations read off on the barrel. If the micrometer should wear slightly, the barrel can be turned around to the 0 mark in the same manner as when adjusting an ordinary micrometer. If the surfaces have been worn at the points where they are mostly used, they can be relapped; if the user of the instrument has no means for accurately lapping them, the corrections can easily be made by the maker of the instrument.

* * *

According to figures compiled by the *Iron Age*, there are nearly 400 electric furnaces in use in the iron and steel industries of the United States and Canada, and practically the same number in the non-ferrous metal industries. Fifty per cent of the electric furnaces in the steel industry are used in steel foundries, and thirty-three per cent of the furnaces in the non-ferrous metal industries are used for foundry work.

BELT-DRIVEN 200-POUND FORGING HAMMER

Among the machines shown at a recent British exhibition was a belt-driven 200-pound forging hammer built by the Bretts Patent Lifters Co., Ltd., Coventry, England. This machine is shown in the accompanying illustration and is provided with a free tup or hammer head, which permits an elastic blow to be given to the work. The belt is normally somewhat slack, but when the hammer is about to deliver a blow, it is tightened by means of a mechanism operated by a treadle in front of the anvil. The belt drives the machine through a combination pulley and flywheel, keyed to one end of a shaft at the top of the machine. An adjustable crank mounted on the opposite end of this shaft operates a short connecting-rod, at the lower end of which is a cross-head in which are housed the upper ends of two spring arms. These arms extend into the tup and have rollers at their lower ends that run on curved paths. In this way the tup is attached to the arms, but as the latter move up and down following the movements of the crank, the tup is allowed a certain elasticity of movement due to the manner in which it is connected to the arms. Adjustment is provided for the tup slides by means of a long taper shoe on one side. The combination pulley and flywheel is fitted with a brake that is applied when the treadle is released.



Belt-driven 200-pound Forging Hammer

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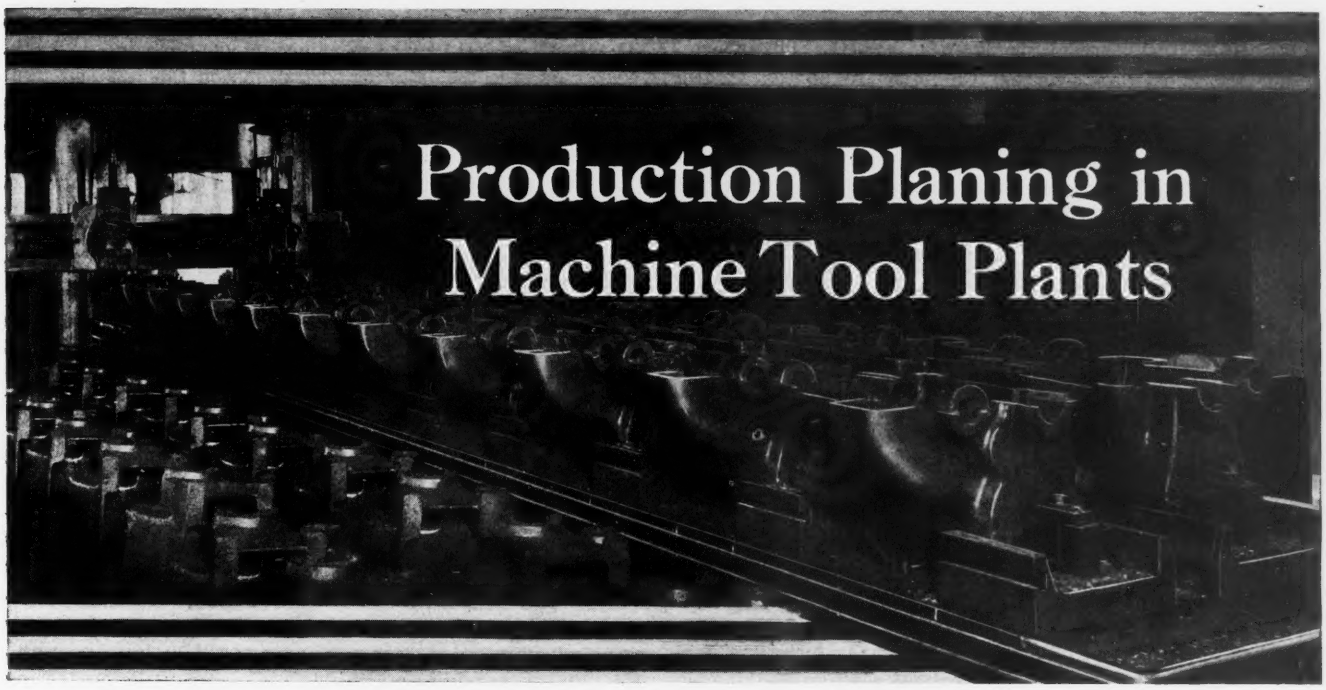
SYSTEM OF FIT ALLOWANCES

In connection with the article published in the January number of MACHINERY entitled "A System of Fit Allowances," our attention has been called to the fact that the method of representing tolerances in a diagram by parabolic curves was originated and first adopted by the firm La Précision Mechanique, 11 rue Vergniaud, Paris, France, in 1912. This firm has made a special study of the question of tolerances, and is believed to have been the first one to have enunciated the parabolic law for clearances, tolerances, and fits upon which the article published in the January number was mainly based.



Production Planing in Machine Tool Plants

Methods Used in Planer-building Shops—Third of a Series of Articles

FROM preceding discussions of the classes of machining operations that are generally regarded as planer jobs, it has been made apparent that one of the most general types of work is the finishing of flat surfaces on large castings. Bearing this fact in mind, one would expect to find that planers are extensively used in plants which specialize in building planers. Naturally, the machine tool builder who is engaged in this line of work believes in the merit of his own products, and as a result one finds that planers are largely used in machining the parts of other planers. In this age of specialization, one would also be justified in expecting the methods used on these jobs to represent the most modern practice in the performance of planing operations, and such is actually the case; but in justice to other manufacturers who have made a careful study of the problems connected with the performance of their planing operations, it is only fair to add that the methods of planing that are used in planer builders' shops do not necessarily surpass in efficiency those which have been developed for use on certain other lines of work. Aside from the fact that most of these operations conform to the latest practice, much of this planer work involves the handling and setting up of large castings, and its discussion in the present article will doubtless prove of value to many who could use similar methods for handling work of this character in their own shops. In this connection, attention is called to the fact that all of these methods are of general application, and they could be successfully used with slight modifications for the planing of many different classes of work.

Accuracy Attainable in Performing Planing Operations

In machine building, it is quite a general practice to scrape two planed surfaces that are required to fit perfectly and to run in contact with each other. This procedure is extensively followed in finishing such work as the slide bearings on various types of machine tools, and there is no question concerning the ability of a skillful workman to produce a satisfactory bearing through scraping two planed surfaces to a final fit. However, scraping not only requires the employment of an experienced and consequently high-priced workman, but it is also a slow and tedious operation, so that the scraping of bearings to a final fit represents no small expenditure of both time and money.

For several years, the G. A. Gray Co., Cincinnati, Ohio, has maintained that by paying more attention to the setting up of planer work and to the performance of planing operations, it would be possible to eliminate much of the scraping that is now done on surfaces which have previously been finish-planed. It is the contention of this company's engineers that practically as well as theoretically, the planer furnishes an ideal method of machining flat surfaces which are required to be straight in both longitudinal and transverse directions. Attainment of such results in the performance of planing operations, presupposes the use of an accurate planer that is in perfect adjustment; and it is also necessary for

General statements are likely to prove misleading; but probably it is safe to state that many shop men consider it necessary to perform subsequent scraping operations in order to bring planed surfaces to a high degree of accuracy. As a matter of fact, the results obtained where the most approved methods are employed in planing have shown the fallacy of this idea, and in certain cases subsequent scraping of planed surfaces is likely to prove detrimental rather than beneficial. Admittedly, it is often considered necessary to scrape certain bearing surfaces after the preliminary work has been done on a planer; but there are other cases where the use of suitable methods of planing produces a result that fulfills all practical requirements. In this connection, especial emphasis is laid upon the desirability of completing a job by planing in all cases where interchangeability of the planed parts is required, as in the case of planer tables on their beds; also, the scraping of planed surfaces is likely to prove detrimental to the accuracy obtained in planing the fits between members of such structures as the bed, housing, and top brace of a planer. In the present article, there is presented a statement of the experiences of several planer builders in the use of machines of the type which they manufacture, and especial emphasis is laid upon the possibility of holding the dimensions of planed work within close limits.

the work to be set up in such a way that it is held without producing strains resulting from either the unsupported weight of the work or from the pressure applied by the clamps that are used to hold it down on the planer table.

Last, but equally as important as the two preceding factors in the attainment of accuracy in precision planing, is the use of tools which are of the types best suited for performing their respective operations; and these tools must be properly ground to give the required clearance and rake angles, and to present a keen cutting edge to the work. Where all of these points receive the proper attention, it is not claimed that scraping can always be eliminated; but results which are regularly produced in planing parts of G. A. Gray planers have shown conclusively that in many cases the finish-planed surface is better adapted to fulfill a given set of conditions without subsequent scraping, than would be the case if a lot of time were to be spent in going over the previously machined surface with a scraping tool.

Planing V-bearings on G. A. Gray Planer Beds and Tables

The citing of a few typical examples of practice followed by the G. A. Gray Co., in planing parts of the planers of its manufacture, should serve to clear up any misunderstanding which may have been formed in reading the foregoing general discussion. Consider the work of planing the female V-bearings in a planer bed and the male bearings on the table that is to subsequently be assembled on the bed. This work has been developed to a point where users of Gray planers are able to order a new table by simply specifying the size and type of machine, and when it is delivered to the consignee's shop, a new table will fit without scraping. Tables are interchangeable on the beds, end for end. This calls for the planing of V-bearings which are perfectly straight, accurately spaced, and with their sides properly inclined to each other; and such results are produced with finish-planing tools, without depending upon the scraper to fit one of the contacting bearing surfaces to the other.

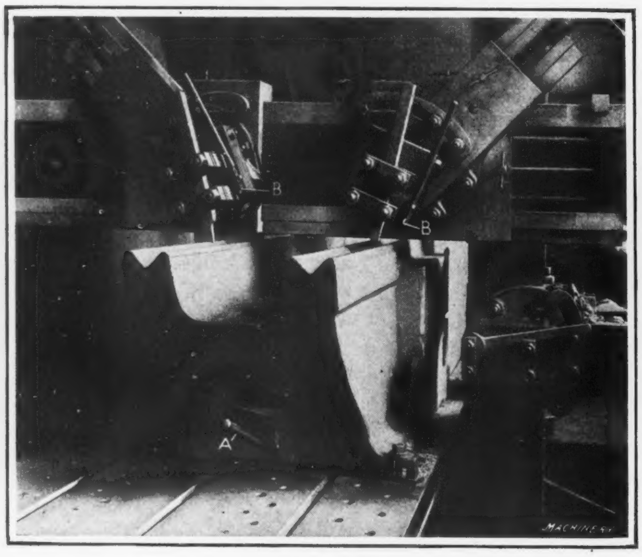


Fig. 1. Close-up View of the Tools used for simultaneously finish-planing Two Sides of the V-bearings in a Planer Bed

As a matter of fact, the V-bearings in Gray planer beds and on the tables are scraped by applying diagonal strokes of the tool, first in one direction and then in the other, with the result that the tool forms a series of diamond-shaped intersections over the work; but the purpose of this scraping is simply to remove any partially abraded particles of metal that might be adhering to the planed bearing, to harden the surfaces, and to create a condition which is more favorable to efficient lubrication. The scraping has no influence upon the fit between the bed and table bearings, as the procedure followed consists merely of going over the work with two series of diagonal strokes in the manner previously described, and a practice is not made of testing the bearing with a film of red lead and scraping down the high spots. The work of fitting the bearings is completed during the course of the finish-planing operations on the bed and table castings.

Planing Fits to Assure a Precise Angular Relationship of Machine Members

In the preceding discussion, mention has been made of the possibilities of planing as a method of obtaining accurate fits between bearing surfaces, but the possibilities of the planer for the performance of precision work are by no means confined to such operations. Another most useful application is in the finishing of surfaces that are to be assembled together, to provide a definite angular relationship between two contacting members of a machine frame or any similar structure. A typical example of this kind is in the planing of the contacting surfaces between the planer housings and bed, and between the top brace and housings.

Attention has been called to the fact that the planer produces a theoretically straight surface. Where the necessary care is taken to obtain the required angular relationship between machined surfaces on a piece of work, the members of a frame built up with planed surfaces at the joints are likely to possess their maximum possible rigidity, due to the uniform bearing that is obtained between the contacting surfaces. Also, such a frame is likely to be more accurate, owing to the ability of the planer to finish one surface at exactly the specified angle to the other surface with which it comes into contact. Scraping will give a satisfactory bearing, but there cannot be the same assurance of accuracy in the angular relationship between surfaces that have been scraped, as there is in the case of carefully planed surfaces.

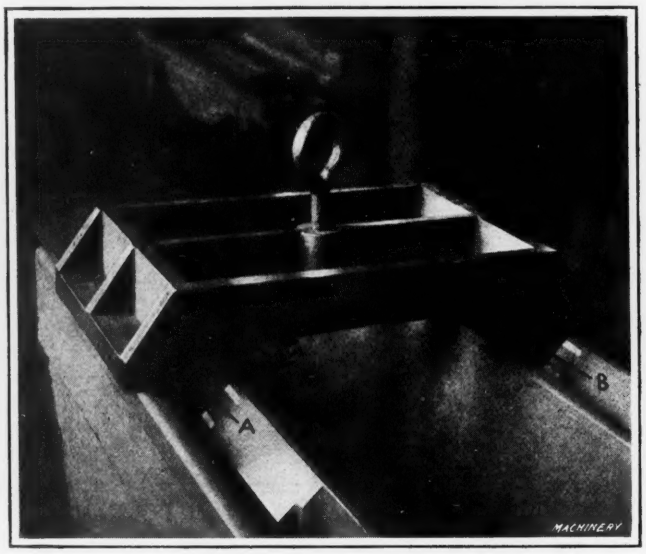


Fig. 2. Close-up View of Gage and Tissue-paper Feelers for testing the Accuracy of Planer Bed Bearings shown in Fig. 1

Setting up G. A. Gray Planer Beds for Planing

Fig. 1 illustrates a 48- by 48-inch by 30-foot Gray planer engaged upon the performance of a finish-planing operation on the V-bearings in the bed of a G. A. Gray planer. After the discussion of methods used in handling planing operations on various types of machine tools, which have been presented in earlier installments of this series of articles, there is no need to dwell upon the sequence of cuts that are taken on this particular job. Interest centers upon the precautions which are observed in setting up the work to be sure that it is free from external strains resulting from the unsupported weight of the casting. If care were not taken to avoid trouble of this kind, there would be a tendency for the casting to sag in places, and even though the bearings were straight at the time of planing, they would be sprung out of a true line after the work was removed from the planer table.

Compensating for Effect of Sagging of the Casting

To avoid such difficulties, the method of procedure followed is to first lower the casting on three blocks, two of which are under the corners at one end, while the third block is centrally located at the opposite end of the work. Three supporting points of this kind are bound to afford a solid foundation, but there is little doubt that the weight of the casting would cause it to sag at the center if dependence were to be placed upon holding it from these three points. Hence, supplementary supporting blocks are placed under the casting, using a pry *A* known as a "pinch bar," which is shown under one end of the casting, to raise it sufficiently so that these additional blocks may be pushed into place. The under side of the casting has already been planed, and small paper packings are placed on top of the blocks, the number of packings at each point being adjusted so that a uniform foundation is provided for the work.

It may be desirable to explain at this point that the pinch bar is a pry of the form shown at *A*, with a pointed end which extends into the space between the casting and the planer bed, that is provided by the supporting blocks, and a heel that constitutes a fulcrum point for the pry. When pressure is applied at the outer end of the bar, it provides for slightly raising the casting so that additional paper packings may be placed on top of the blocks or removed, according to the nature of the adjustment that is required. It will be evident that the leverage ratio from the fulcrum to the point and to the end of the handle of the pinch bar is sufficient so that application of a moderate pressure on the handle will result in slightly raising a very heavy casting at a point adjacent to the block where adjustment is being made, in order to allow paper packings to be put in place or removed as may be required.

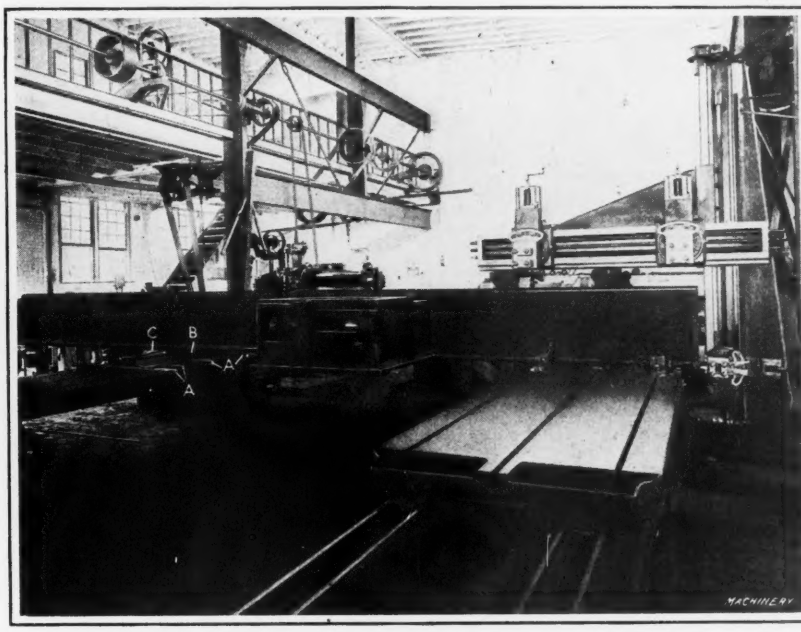


Fig. 3. Use of an Open-side Planer for facing the Ends of the Middle Section of a Three-piece Planer Bed

In using one of these bars, the object is to have the support furnished by packings under the work at each block made exactly uniform. Such being the case, the procedure of the planer hand is to just raise the work with the pinch bar and test the tightness with which the papers are held between each block and the work. The pinch bar is put under one end of the casting at the center, as shown in Fig. 1, and while the work is raised sufficiently for that purpose, the operator takes hold of the first and then the second of the packings above corresponding blocks at opposite sides of the work, and ascertains that they are both held uniformly. If any packing is found to be held too tightly, one or more sheets of paper will be removed; and, conversely, if a packing is found to be too loose, one or more sheets of paper will be added, in order to assure having this supporting point bear its full proportion of the load. With a casting set up in this manner, the operator can proceed with his planing operation with the full assurance that the degree of accuracy attained in planing will be retained when the work is removed from the planer.

At *B* in this illustration, there is shown a convenient form of "lifter" for raising the tool from the work during the return stroke. It consists of a pivoted lever secured to the apron, at the end of which there is a cam in contact with the edge of the tool box. By swinging the lever about its pivotal support, the cam raises the tool out of contact with the work by swinging the apron forward.

Another Method of Using the Pinch Bar

Sometimes it is not possible to apply a pinch bar under one end of the work, and in such cases, the method followed consists of inserting the bar successively beside each of the blocks. This calls for even better judgment than the method illustrated in Fig. 1, because the operator must raise the work at each point until he is able to test the tightness with which the paper packings are held, after which he goes to the next block and repeats the operation, depending on his remembrance of the amount of pressure required to raise the work with the pinch bar, and of the tightness with which the papers were held, to enable him to duplicate conditions at all of the points of support. Naturally, the number of blocks that are placed under a casting will depend upon both its shape and size, and upon the way in which the form of the casting is likely to add to or decrease its flexibility. Large thin castings which are likely to be quite flexible must be supported at numerous points, while in the case of castings of sufficient thickness to afford considerable resistance against flexure, a small number of supporting points will prove adequate. By looking over the illustrations presented in these articles, the reader will be able to judge the number of supporting points for the work that are provided in many different shops.

Gaging Accuracy of Planed Bearings

An idea of the degree of accuracy that is attained in planing Gray planer beds is well illustrated by the use of a gage which is shown in Fig. 2. It will be seen that this tool has two inclined faces *A* and *B* which fit against corresponding sides of the V-bearings; and the gage may be turned around so that these faces also fit against the opposite sides of the two bearings. The test consists of placing a tissue-paper feeler between the work and the upper and lower ends of each of the test points on the gage, as clearly shown in Fig. 2. Used in this way, all four papers must be held in such a manner that no one can be pulled out from between the gage and the work. After finish-planing, this test is repeated at intervals from end to end of the planer bed, and at both sides of the vees; and if there is any point at which all four of the papers are not held between the gage and the work, the finish-planing operation is repeated until the test can be conducted with satisfactory results. This indicates a degree of accuracy considerably in excess of 0.001 inch.

Planing Sectional Bed for Cleveland Open-side Planer

The Cleveland Planer Co., Cleveland, Ohio, specializes in the building of open-side planers, and in Fig. 3 there is illustrated a machine of this type engaged upon the performance of a job for which the open-side planer is well adapted. The piece that is being machined is part of a

Cleveland planer bed, which is of such length that it is required to be made in three sections. The middle section is shown in place on the planer table, and it will be seen that it is flanged at each end so that after the ends of all the sections have been planed square with the ways, they can be held together by means of bolts through the flanges. It is the planing of one end of this bed section which is shown in Fig. 3, the side-head of the planer being utilized for that purpose. This casting is 27 feet long, and it will be seen that one end is strapped down to the planer table by means of three substantial straps at each side.

Of greatest interest in connection with the performance of this planing operation is the method of providing outboard support for the work. This is accomplished by placing a planer table on blocks of sufficient height to hold it at a level about four inches lower than the table of the planer on which the work is mounted. It will be seen that four rollers *A*, made of cold-rolled shafting, have an I-beam *B* placed transversely across them. The casting to be planed is then lowered into place, with one end resting on the planer table and the other end on two pairs of wedges (one of which is shown at *C*) which are placed between the I-beam and the work, with their inclined faces in opposite directions. It will be evident that by tapping opposite ends of the two wedges in each pair, provision is made for adjusting the height of support so that the outboard end of the casting is held accurately at the level of the planer table on which its opposite end is clamped while being machined.

Furthermore, it will be evident that rollers *A* are for the purpose of allowing the planer table to carry the work back and forth, without any tendency for frictional resistance to disturb the setting of the end of the casting on which the planing operation is being performed. There is a saying among experienced planer-hands that a job set up is half performed, and the present example constitutes an excellent case in point. The actual planing operation is quite simple, consisting of taking a roughing cut with a round-nosed tool held by the side-head, using a feed of 1/4 inch and a cutting speed of 45 feet per minute. Then a finishing cut is taken with a broad square-nosed gooseneck tool, with a feed of 1 inch and a cutting speed of 45 feet per minute. The time required for setting up one of these castings and for performing the planing operation at each end is approximately two hours.

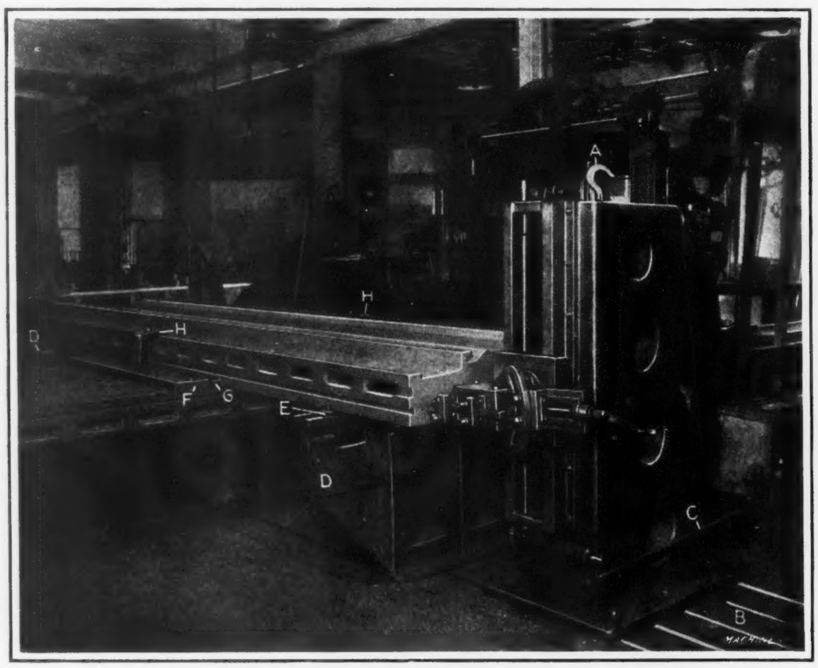


Fig. 4. Use of an Independent Housing carrying a Side-head for planing the Ends of a Sectional Planer Table. Outriggers D are used to support the Overhanging Ends of the Work

Planing Joints of G. A. Gray Sectional Planer Table

A description has just been given of the procedure followed in making long planer beds, where it is desirable to use two or more castings which are accurately abutted together to produce a bed of the required length. In the case of these planers of unusual length, the same general method is employed in making the table, and Fig. 4 shows the performance of the planing operation on one end of such a sectional table casting in the plant of the G. A. Gray Co., on a 48- by 72-inch by 24-foot widened pattern planer of this company's manufacture. This is another case where the work is of too great length for the capacity of a double-housing planer, and the accompanying illustration shows a substitute for the open-side type of machine. It consists of employing what is known as an "independent housing" which is furnished with a hook *A* at the top, so that it can be conveniently carried by a crane and placed beside any double housing planer in conjunction with which the independent housing is to be used. Where equipments of this kind are frequently employed, a practice is made of setting floor plates *B* transversely beneath the planer bed, so that a level foundation is provided for the independent housing; this foundation has T-slots machined in it to receive the heads of bolts that hold the independent housing in place. From the illustration it will be evident that there is a link mechanism *C*, which is connected to the regular planer feed and transmits motion to a vertical screw which feeds the head on the independent housing.

Provision for Overcoming Flexure of the Work

For holding a long casting such as the one shown placed transversely on the planer table, flexure of the work would make it impossible to plane the ends perpendicular to other previously finished faces, unless some auxiliary support were furnished to supplement that of the planer table. The means provided for this purpose consist of the use of what are known as "outriggers." Two of these devices are mounted on the floor plate, as shown at *D*, about midway between the sides of the planer table and the ends of the work. Each of these outriggers is furnished with a shoe *E* upon which the work rests, and this shoe slides on a bearing at the top of the outrigger. It will be seen that the upper member which carries the bearing for the sliding shoe is made independent of the foundation, so that adjustment is furnished to take up any twist in the casting, regardless of whether or not the foundation is absolutely level.

Previous to the planing of the end joints on this table casting, the top, bottom, and sides have been finish-planed, and one of these side faces is used as a locating point for setting up the work for performing the present operation. It will be seen that a special form of end-stop *F* is bolted to the planer table, and a parallel strip *G* is placed between this stop and the work, both the strip and the sides of the stop being carefully planed so that they are absolutely straight and parallel. Then the work is held down by a single strap *H*, and there is a similar strap at the opposite side of the work, dependence being placed upon the weight of the casting to assist in holding it down. The sequence of planing operations consists of taking a roughing cut with a round-nosed tool and a semi-finishing cut with a square-nosed tool; then one or more finishing cuts are taken until the end joint has been planed up so that tests show it to be square with the previously finished ways on the planer table.

Fig. 5. Planer equipped with Multiple Tools and an Indexing Mechanism for planing the Teeth in Planer-table Driving Racks

Planing Teeth of Driving Racks for Cincinnati Planer Tables

The rack which is secured to the under side of a planer table, and meshes with the bull wheel is often made in sections. Large numbers of such racks are required by the Cincinnati Planer Co., Cincinnati, Ohio, for use on machines of its manufacture, and Fig. 5 illustrates the way in which a Cincinnati planer has been tooled up for the manufacture of these parts on a quantity production basis. From this illustration it will be apparent that the entire planer table is covered with rack blanks which have been previously planed to the desired form, with shoulders at each end which fit under clamping strips that run down both sides of the planer table. The rack blanks are lined up transversely by utilizing their previously planed side faces, the end blank being placed in contact with stops on the planer table.

It will be noticed that each of the rail-heads on the planer is provided with a multiple tool which cuts three tooth spaces at a time, and the actual operation of planing the rack teeth is quite simple. After one set of three teeth has been cut to depth by the tool on each of the two planer heads, the heads are raised and traversed over a distance equal to three times the longitudinal pitch of the rack teeth, utilizing the planer cross-feed mechanism for obtaining this index movement, after which the heads are lowered and the machine is ready for taking the next cut. It will be seen that there is an indexing dial *A* mounted on the cross-feed screw, and an index pointer is carried by a bracket *B* secured to the top of the cross-rail. With this arrangement accurate spacing of the teeth can be obtained. Equipped in this manner, a planer is able to give efficient results in the performance of rack cutting operations. The rack teeth are first roughed out six at one time with a multiple planing tool in each head. They are then finished accurately to size with formed tools fitted to special tool-blocks. The nature of the work permits the rail to be lowered extremely close to the table and creates a condition that is ideal for rigidity and securing a smooth cutting action, so very essential to work of this kind. The racks shown in process of being cut in the present illustration are 3 feet long by 7 inches face width and they have 3-pitch teeth. Twenty-two of these racks are set up on the machine at a time, and the teeth of all these racks are completely cut in twelve hours. The material is semi-steel.

Planing Knees for Cleveland Open-side Planers

An open-side planer built by the Cleveland Planer Co. is shown in operation in Fig. 6 planing a string of three knees for use in supporting the cross-rail on machines of this type. As the work comes to the machine for performing this operation, the face to which the cross-rail is to be secured has been planed, and this surface is utilized as a locating point, the work being strapped to the planer table. After the castings have been squared up and secured in place, the sequence of operations performed is as follows: The first operation consists of planing the top face *A* with a tool carried by the rail-head. Then a round-nosed tool, held in a horizontal position by the side-head, is fed vertically down face *B* until it reaches a position slightly above the top *C* of a lock bearing by which the finished knee will be secured to the face of the planer housing.

At this point, a tool-holder is substituted in the side-head, of the form shown in Fig. 6. It is held in a horizontal position and has the cutter bit projecting vertically downward, so that this tool can complete the cut down surface *B* and also down the inside vertical face of lock bearing *C;* after taking these two cuts, the tool is fed vertically down between the two side faces of the lock bearing, in order to provide for rough-planing that portion of the bottom surface which was not reached by the tool at the conclusion of the planing operations on the two vertical sides. The same tool is also used to perform a rough-planing operation on the horizontal top surface of lock bearing *C*.

Next in the order of operations comes the finish-planing of top surface *A* with a broad-nosed gooseneck tool carried by the rail-head; and a tool of similar design carried by the side-head is utilized to finish-plane surface *B*. Then the inside and bottom surfaces of the lock bearing, and its top surface *C*, are finish-planed with a broad-nosed tool, the finish-planing operations on the inside of this bearing being

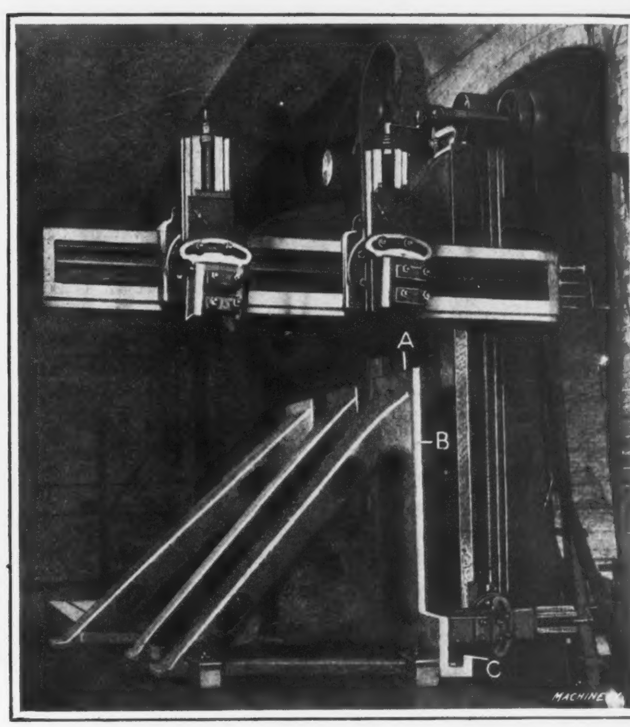


Fig. 6. Open-side Planer used for completely planing the Column Bearing in Open-side Planer Knees

continued until the width of the space has been worked out to a point where it tests up properly with a length gage used for that purpose. On this job, experience has shown that six hours are required to plane one of these knee castings and that three castings can be completely planed in twelve hours, which serves as a good example of the increased output which results from multiple set-ups for performing production planing operations.

Fixture for Planing Tapered Gibs for Sellers Planers

For use in machine tools built by William Sellers & Co., Inc., in Philadelphia, Pa., a number of the familiar form of tapered gibs are required to provide for making adjustments in the fits of various slides, etc., after the machines are placed in service. For use in planing these gibs, a fixture is employed which is illustrated in operation in Fig. 7. It will be seen to consist of a bridge *A* on which the work *B* is carried. At the time when the gib blanks are set up on this fixture for planing, all of the required machining operations have been performed with the exception of finishing the tapered side, and it is to provide the proper setting for finishing this taper that the present fixture is employed. It will be seen that the bridge *A* is supported by posts near each end, the bridge being carried at the end nearest the planer cross-rail by means of a pivot *C*, while at its outer end there is a bolt *D* that projects through the posts which are slotted to afford the necessary adjustment, so that the gib blank may be held in the proper position for performing the taper planing operation. Work *B* is held down on the bridge *A* by means of screws, which project upward through the bridge and enter tapped holes in the under side of the work.

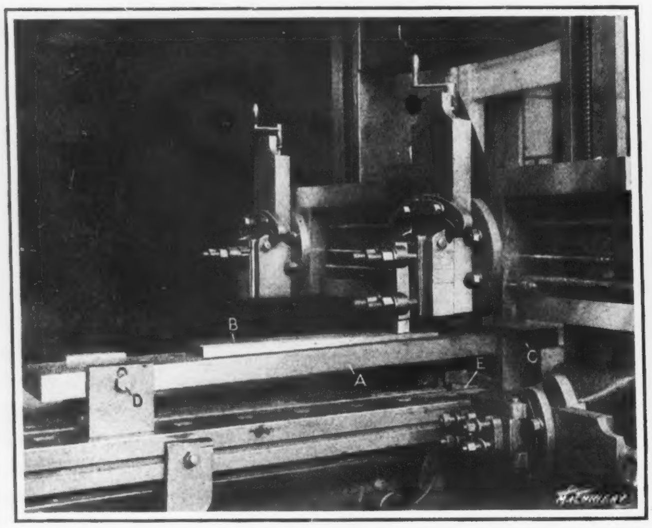


Fig. 7. Adjustable Fixture used for planing Tapered Gibs with Various Taper Angles

It will be seen that the posts which support this fixture are bolted to the planer table and that the under side of each post is grooved to receive a tongue *E* that fits into the table T-slot and provides for properly aligning the fixture with the line of table travel. Setting of the position of bridge *A* for obtaining any required taper on a gib is accomplished by means of a master gib that is first placed on the bridge. A dial test indicator is then mounted in the planer toolpost and the angular position of the bridge adjusted until a uniform reading is obtained with the plunger of the indicator in contact at various points along the master gib. Obviously the planing of gibs calls for a high degree of accuracy, and it is the practice of the Sellers plant to perform a roughing operation with the familiar round-nosed tool, after which a finishing cut is taken with a round-nosed tool that has a flat about 1/16 inch in width ground on its point. For cutting steel, the top rake of this tool is made 22 degrees.

Use of Magnetic Chucks in Planing Small Parts of Cincinnati Planers

In handling small pieces of work, and more particularly those which are of fairly regular outline and which are produced in quantities, advantageous use can be made of a magnetic chuck for holding the pieces for planing. As in all cases where magnetic chucks are used, the application of this principle of holding the work results in saving time in setting up. But or planer work, the thrust of the tools is likely to be great enough to cause trouble from shifting the endwise position of the pieces unless special precautions are taken to overcome difficulties of this kind. Fig. 8 shows the use of a magnetic chuck made by the Heald Machine Co. of Worcester, Mass., on a 30- by 30-inch by 6-foot Cincinnati planer in the Cincinnati Planer Co.'s plant, where it is employed for holding four rectangular shaped blocks, and this illustration clearly shows the means provided for preventing endwise movement of the work. It consists of providing a rail *A* at the end and at one side of the chuck which extends slightly above the face but not as high as the top surface of the work to be planed.

With an arrangement of this kind, the castings are placed in contact with the end wall which supports the thrust of the tool, and the side wall can be utilized for the double purpose of locating the work and assisting the magnetic action of the chuck in holding it in place for planing. Such a double use is illustrated in Fig. 8, where it will be seen that straps *B* are held in a T-slot at the edge of the magnetic chuck and they are used to push the castings back against the wall *A*. In the present instance, their function is chiefly that of locating the work, but if additional holding power were required to supplement the magnetic action, stops could be set in the T-slot and "butters" inclined downward from the stop-screws to the sides of the work, so that they would not only push the work into contact with the side wall of the fixture, but also apply a downward component force that would assist in holding the pieces while they are being planed. The pieces shown in process of planing are saddle clamps made of cast iron. They are planed on the top, bottom, and sides, and two edges are rounded. It takes an hour and fifty minutes to set up and plane four castings.

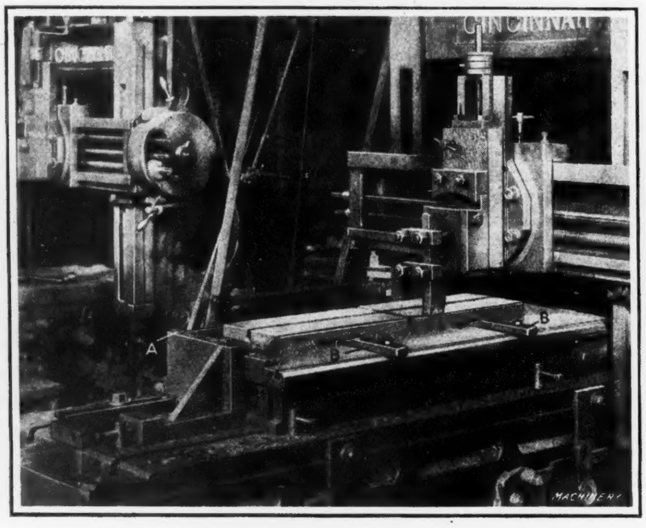


Fig. 8. Use of Magnetic Chuck for holding Small Pieces of Planer Work

* * *

Concentration of industry is the keynote of the German industrial reorganization. A typical instance is the merger of the Stinnes coal and iron trust with the Siemens-Halske Electrical Co., whereby 200,000 workers are controlled by one concern producing coal and steel and manufacturing machinery. In the field of banking a similar tendency is noted in the fusion of several large banks.

The Metric Equivalent Scheme

By FREDERICK A. HALSEY, Commissioner of the American Institute of Weights and Measures, New York City

SOONER or later most machine shop advocates of the metric system take refuge in the metric equivalent scheme, by which is meant the continued use of existing sizes measured and expressed in metric units. In MACHINERY for August, 1920, Theodore H. Miller tells us his experience with this plan in the production of De Laval separators. That there may be no doubt that the same thing is being discussed, the following quotations from various parts of this article are given here: "We simply adopted metric measurements for the machines we were already manufacturing." "Dimensions in millimeters were placed on the old drawings directly under the inch dimensions." "It is not the dimensions of the work that are changed at first, but simply the nomenclature pertaining to the sizes."

It is to be admitted at once that this procedure is physically possible, but the question before us is: Does this procedure bring about that simplification and those advantages which we are told will attend the adoption of the metric system? In what follows several questions will be asked Mr. Miller. They are asked seriously, expecting direct answers.

Drawings

In Fig. 1, supplied by L. D. Burlingame, is given an application of this plan to the spindle of a Brown & Sharpe milling machine. Will the reader endeavor to discover the advantages of the metric figures? For the benefit of those who fail, we would like to have them pointed out.

Screw Threads

In Table 1, are given some metric equivalents of English diameters and pitches of screw threads. The third column gives also the metric equivalents which, according to the previously mentioned article, are used in place of the English figures of the first column for machine parts in general. Will Mr. Miller say if he and his workmen have committed the figures of the third and fourth columns to memory and, if not, will he explain how he avoids the use of the English figures? The reader should note that the scale of sizes to be used must be carried in the mind, that the English figures are repeated for each inch and, forming a simple series, memorize themselves, while the metric equivalent list, being endless and following no law, is as impossible to memorize as a table of areas of circles.

TABLE 1. METRIC EQUIVALENTS OF ENGLISH SCREW THREADS

English Dimensions		Metric Equivalents	
Diameter, Inches	Pitch, Threads per Inch	Diameter, Millimeters	Pitch, Millimeters
1/4	20	6.35	1.27
3/8	16	9.53	1.59
1/2	13	12.7	1.96
5/8	11	15.88	2.31
3/4	10	19.05	2.54
7/8	9	22.23	2.82
1	8	25.40	3.17
1 1/4	7	31.75	3.63
1 1/2	6	38.10	4.23

Machinery

When cutting a screw of 10 threads per inch = 2.54 millimeters pitch, the lead-screw of the lathe having 4 threads per inch = 6.35 millimeters pitch, we may find the ratio of the change-gears by either of the following calculations:

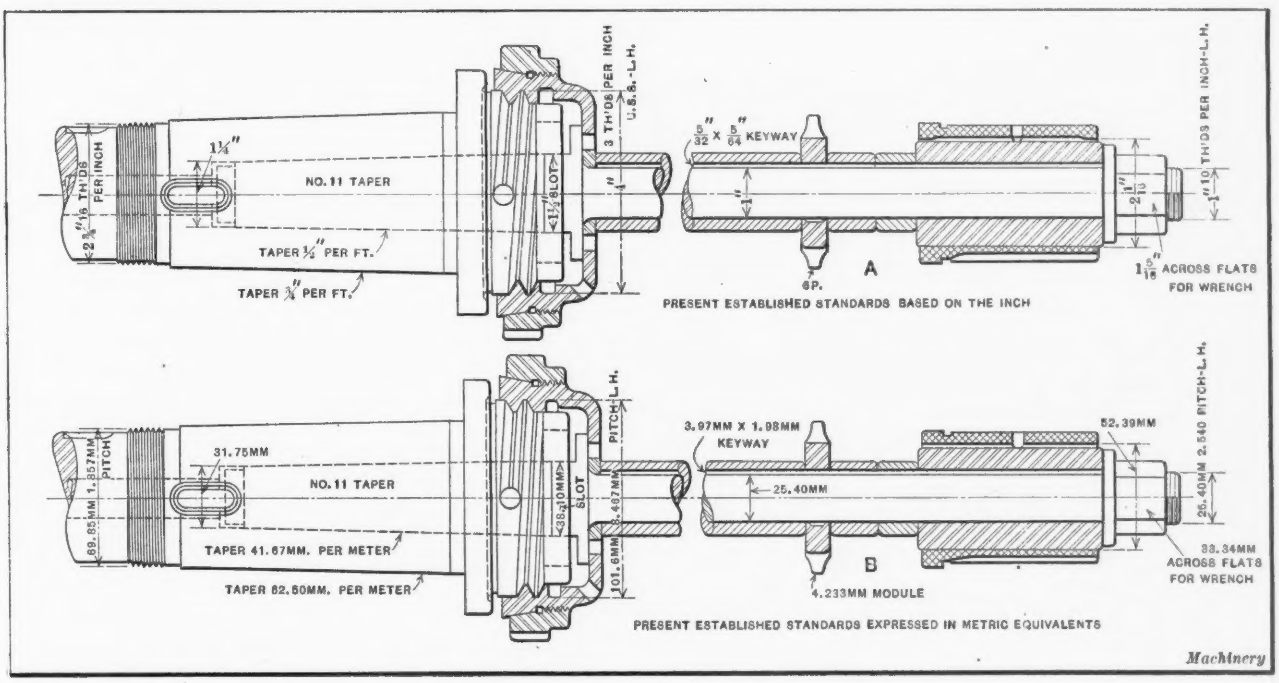
English Calculation

$$\frac{10}{4} = 2\tfrac{1}{2}$$

Metric Calculation

$$\begin{array}{r} 2.54)\ 6.35\ (2.5 \\ 508 \\ \hline 1270 \\ 1270 \\ \hline 000 \end{array}$$

Can anybody tell what advantage is found in the metric calculation?



The Metric Equivalent Scheme at Work

If the lathe at hand is of the older type with an index-plate, that plate will give, for the English pitches, the gears required at a glance and without calculation, while no lathe has an index-plate reading in the equivalent metric figures. When using such a lathe, is the making of the foregoing metric calculation for the ratio, followed by hunting out the gears for that ratio, preferable to taking the gears directly from the index-plate? If the lathe at hand is of the newer type an explanation will be welcome of how metric figures can be used at all.

Gear-cutting

In Table 2 are given some English diametral pitches of gears with equivalent metric modules.

TABLE 2. METRIC EQUIVALENTS OF ENGLISH DIAMETRAL PITCHES

English Diametral Pitch	Metric Equivalent Module	English Diametral Pitch	Metric Equivalent Module
4	6.350	9	2.822
5	5.080	10	2.540
6	4.233	11	2.309
7	3.628	12	2.117
8	3.175		

If we are to cut a gear of 8 pitch = 3.175 metric module, and of 6 inches = 152.4 millimeters diameter, we may find the number of teeth by either of the following calculations:

English Calculation

$8 \times 6 = 48$

Metric Calculation

```
3.175) 152.40  (48
       127.00
       ------
        25400
        25400
        -----
          000
```

The result is identically the same gear in both cases. Are the metric modules really used in preference to the English pitches, and is the metric calculation made in preference to the English calculation?

The foregoing are but simple examples that might be multiplied indefinitely. They show what always happens when standards that have been developed in units of one system are measured in those of another. The change always results in figures which are worse than those with which we started, impossible to remember* and meaningless to those who attempt to use them, while calculations are always made more complex and time-consuming.

Draftsmen's Scales

Mr. Miller tells us that "at the present time in the De Laval plant all micrometers, scales, and other graduated instruments read in the metric system," which we are bound to understand includes draftsmen's scales. The lines on an English draftsman's scale show the sizes to be used when the English system is followed, as the lines on metric scales show the sizes to be used if the metric system is followed, but *the lines on the metric scale give no clue to the English sizes* and, moreover, except at five inches and multiples thereof, the English sizes always fall between the metric lines, and must be laid down on the drawing by estimation.

As, according to the above statement, the dimensions of the work are not to be changed, the draftsman must lay down English sizes with such a metric scale. Will the reader imagine himself a draftsman with a metric scale and attempting to lay down such dimensions as 5/8, 1 1/4 and 2 1/2 inches? Do they really use metric scales in this manner and if they do, how do they locate the dimensions?

De Laval Practice

This last question becomes pertinent when we examine a copy of the De Laval catalogue No. 104 relating to the centrifugal oil purifiers manufactured by that company. This catalogue, which was given to all inquirers at the recent chemical exhibition in New York, contains two pages of tables with key diagrams of leading dimensions of the various sizes and patterns of those purifiers. The tables consist of eleven columns of figures the dimensions listed numbering 162, and every one of these dimensions is in English feet and inches and binary fractions, not one being metric. Recalling that we are told: "It is not the dimensions of the work that are changed *at first*" and also that "the change took place twelve years ago" it would be of interest to know, with especial reference to this table, how many years are meant by the expression "at first."

The table shows that the English system is still used by this company after twelve years of effort to get rid of it, and that it is still confronted with the necessity of constant conversions between the two systems, wherein is repeated the experience of every manufacturer and of every country that has attempted to adopt the metric system.

The Results

Table 3 shows what these conversions will be like, and they will be far more frequent than conversions between our present units. Things that we need in small quantities are bought by the ounce, and things needed in larger quantities by the pound. The two units are almost never mixed and conversions between them are seldom made. On the other hand, the pound and the kilogram are used for the same purposes and conversions between them will be frequent. For the same reason we will have frequent occasion to make conversions between the inch and the millimeter, the square inch and the square centimeter, the foot and yard and the meter, the square foot and square yard and the square meter, the mile and the kilometer, the square mile and the square kilometer, the quart and gallon and the liter, the bushel and the decaliter, the acre and the hectare, the pound per square inch and the kilogram per square centimeter, the bushel per acre and the decaliter per hectare, and so on to the end, and the necessity for these conversions will continue until the English units are discarded, which the De Laval catalogue shows has not been done. It is these conversions that nullify all claims for economy of time in calculations due to the metric system.

The Usual Answer

The usual answer to such questions as those that have been asked is that these equivalents will be used during the transition period only and will ultimately be discontinued —an answer that is clearly foreshadowed in the quotation given above: "It is not the dimensions of the work that are changed *at first*."

Passing by the established fact that, after a century and a quarter of effort, France is still in the transition period, it may be asked: If these equivalents are satisfactory why should they be discontinued? If they are to be discontinued can it be for any reason except that they are not satisfactory? They must be used so long as existing standards endure, and they can be discontinued only by discarding the standards which they are, "at first," used to measure.

As an inducement to adopt the metric system we are told that we will preserve existing standards by the use of metric equivalents but, when we show how absurd they are, we are told that, sometime in the future, the equivalents will be discontinued, although that can be done only by discarding standards. That is to say, we are asked to get into this quagmire with the understanding that standards will not be changed when, in fact, the change is only to be postponed. Will it be easier to change the standards of shafting, pulleys, screw threads, pipe threads and diametral pitch gears ten years hence than now? Is it not, on the contrary, clear that the further standardization goes the greater will be the difficulty? And progress in standardization was never so rapid as now.

*Compare the English pitches and metric modules of Table 2.

Swedish Practice

At the end of the article under discussion is given a quotation from Erik Forsberg telling us how "suddenly but fully" the metric system was adopted in Sweden.

In MACHINERY for August, 1920, page 1139, there appeared a letter from J. Christian Barth, son of Carl G. Barth, outlining his observations and experience during three and a half years' residence in Norway and Sweden. Mr. Barth explains that, having occasion to make some drawings of equipment and not being familiar with the metric system, he was told to make them in the English system and that, later, he learned that the Swedish metal industries use no less than four systems of measurement. He also states that piping, iron bars, shafting, etc., are *always* stated in English measure, and bolts, nuts, and similar articles in both English and metric measures, and he gives an instance of rivets of which the diameter was measured in inches and the length in millimeters.

In the following is given an extract from *Commerce Reports* for February 11, 1920: "According to Trade Commissioner A. X. Oxholm, lumber exported by a company in northern Sweden is cut as follows:

69% to English ft.		
7% to Danish ft.	(1 Danish ft.	= 0.9711 English ft.)
8% to "Metric" ft.	(1 "Metric" ft.	= 1.0936 English ft.)*
7% to Spanish ft.	(1 Spanish ft.	= 1.0783 English ft.)
4% to Dutch ft.	(1 Dutch ft.	= 1.0768 English ft.)
4% to German ft.	(1 German ft.	= 1.0639 English ft.)
1% to decimeters	(1 decimeter	= 3 15/16 inches)

* = 1/3 meter

Clearly Mr. Forsberg overlooked the Swedish lumber industry when making his sweeping statement. And please note the various feet to which "metric" countries require lumber to be cut, not overlooking the (save the mark) *metric foot.* The time has come for the metric party to recognize that they can no longer claim that any country has discarded its old units for the new. Evidence that they have not has been accumulating for twenty years until it is mountain high and unassailable, and it is this which turns the metric case to ridicule. We are urged to adopt the metric system for the benefit of export trade, but Sweden has been compelled to keep the *old measures* for the benefit of export trade! Thus do facts confound the metricites.

New Ratios

If the new units are merely to be added to the old, as is universal in all so-called metric countries, not only will we have more units than now, but we will also have a new class of ratios—those between the English and the metric units, and of these a few examples are given in Table 3.

TABLE 3. A FEW RATIOS BETWEEN ENGLISH AND METRIC UNITS

25.4	millimeters make	1	inch
6.452	square centimeters make	1	square inch
3.281	feet make	1	meter
10.724	square feet make	1	square meter
1.609	kilometers make	1	mile
2.59	square kilometers make	1	square mile
2.205	pounds make	1	kilogram
28.35	grams make	1	ounce
2.471	acres make	1	hectare

Circular No. 47 of the Bureau of Standards on "Units of Weight and Measure" contains forty-five pages of conversion tables between English and metric units, and we are asked to add these tables to our system of weights and measures as the first step in the process of simplification. Under the plan for the use of metric equivalents for English sizes, these tables will become a part of our system of weights and measures, to endure until the English units are discarded, yet the old units are not discarded in France after a century and a quarter of effort backed by compulsory law and national pride of achievement.

Belief versus Fact

The fathers of the metric system may be excused for believing that a country may change its weights and measures since they had no experience to guide them, but today the world has a century and a quarter of experience behind it. It is no longer necessary to consider anyone's belief, and still less is it necessary to consider the optimistic hopes of enthusiastic innovators. It is only necessary to consult the facts, and the facts show the attempt to adopt the metric system to be a repeated failure.

No one doubts and no one denies that, in many applications, the metric system may be used without much difficulty and, in the light of the experience of other countries, no informed man doubts or denies that in many other applications its adoption is hopeless. The problem before us is not the introduction of metric units in easy cases, but the getting rid of English units in difficult cases. The whole problem must be approached with that idea in mind.

Twenty years of investigation of this subject have shown no case of an established, developed industry that has changed its system of weights and measures. New industries have, of course, been developed in and by the metric system, but the old ones do not change. Among the industries that antedate the metric system and that are universal are lumber, building, and textiles, and we need no better illustrations of this fact. The mill units of the French silk industry are the pre-metric French units, while French builders require their lumber to be sawed to the inch. The watch industry in Switzerland still employs the ancient units.

An application wherein old units everywhere refuse to budge is to the measurement of land. Of this we have at home two perfect examples in the use of the French arpent in Louisiana and the Spanish vara in Texas, the latter being universal and the former very common. The first settlements in Canada were made by the French, and in French Canada to-day land is measured by the old French non-metric units although in other parts the English units are universal. It is commonly said and believed that the metric system is universal in chemistry, and it is substantially so in the chemical laboratory, but out of twenty reports received from American manufacturers of chemicals nineteen of them use nothing but English units in the operation of their factories.

The people everywhere do not like the metric system. Nowhere do they use it except to the extent required by law, and in many countries the law is a by-word and a farce. The approving opinion of a few individuals is lost in the disapproving chorus of the peoples and the nations.

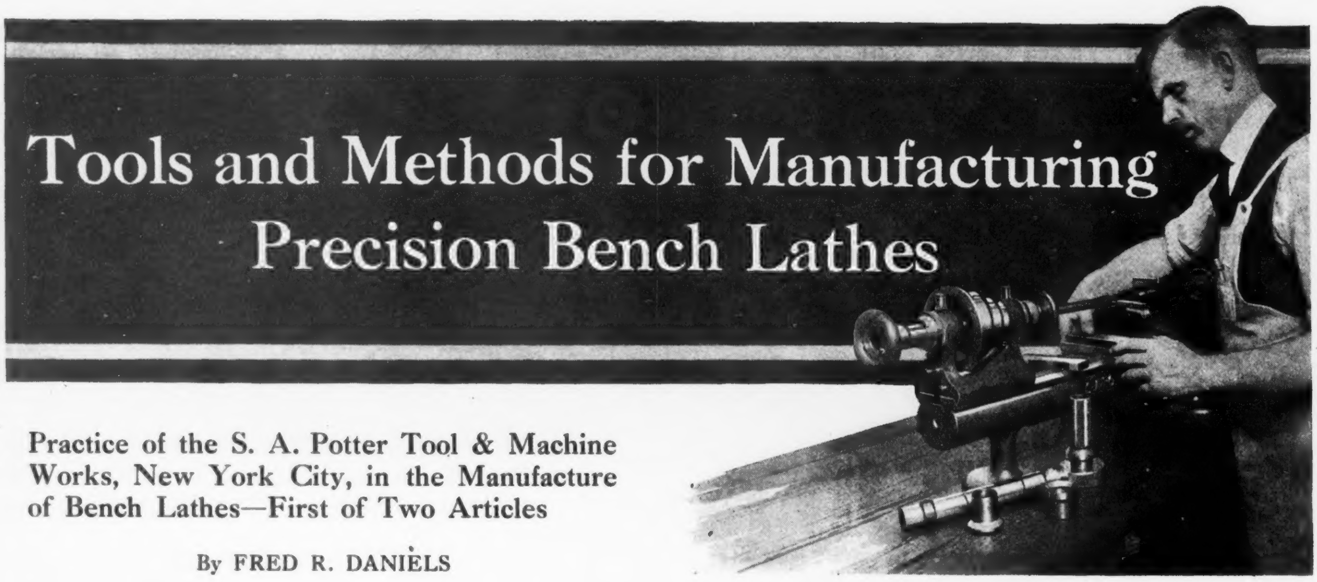
The Real Issue

Wherever the inquiry has gone, and it has covered pretty nearly the entire world, the result is uniformly to find a mixture of systems. The old discussion of the English versus the metric system has thus become an idle diversion. The only subject worth discussing is the English versus a mixture of the English and metric systems, and what we object to is not the metric system *per se* but the mixture of systems that is everywhere the result of the attempt to adopt the metric system.

We must compare what we have with what we will get, not with what the metric advocates hope we will get, and we will get what others have got—a mixed system that will have more, not fewer, units; more and worse, not fewer and better, ratios; in which calculations will be more, not less, complex; of which school children will have more, not less, to learn, and by reason of which every claim and argument made for the metric system is, like these, not only destroyed but inverted.

The persistence of old units in all so-called metric countries is the skeleton in the metric closet.

Tools and Methods for Manufacturing Precision Bench Lathes



Practice of the S. A. Potter Tool & Machine Works, New York City, in the Manufacture of Bench Lathes—First of Two Articles

By FRED R. DANIELS

AUTOMATIC single-purpose machines, elaborate jigs, indexing and other fixtures, carefully worked out inspection methods, all of which entail a high first cost, readily find a place in the shop of large manufacturers. There is, however, a class of machine-tool builders whose volume of business does not always warrant the utilization of such elaborate and expensive equipment. The manufacturer whose output requires the machining of large quantities of duplicate parts, finds his single-purpose machine and his standardized equipment an economical investment. His volume of business justifies the heavy first cost involved. On the other hand, the smaller manufacturer is at a great disadvantage when it comes to constructing or purchasing special automatic machinery, because he must carefully consider whether or not the expenditure involved will be covered within a reasonable length of time by the increased profits resulting from its use.

The S. A. Potter Tool & Machine Works, in manufacturing precision bench lathes, has adopted only such methods and devices as the volume of its business has shown to be judicious. Whenever a manufacturing problem involving costs arises in this shop, the selection of the proper machine or tool is carefully considered. If the length of time necessary to recover the proposed expenditure extends over a number of years, the investment is considered questionable, and other means are devised that are simpler and cheaper but none the less effective. The fact that the Potter precision lathe is successfully manufactured on such a basis is proof that this is good manufacturing procedure. This article describes a number of operations in which rather unusual methods are used or in which time-saving and inexpensive equipment has been employed.

Finishing the Lathe Beds

For convenience in describing certain operations on the lathe units, the sectional view, Fig. 1, of the headstock, mounted on the end of the lathe bed will be referred to. The lathe bed A is machined by milling and grinding the top bearing surfaces. The practice of milling, while not general, is quite commonly followed in machining beds of lighter machine tools. The practice of planing castings of this type is also quite common, and in the case of the heavier machine

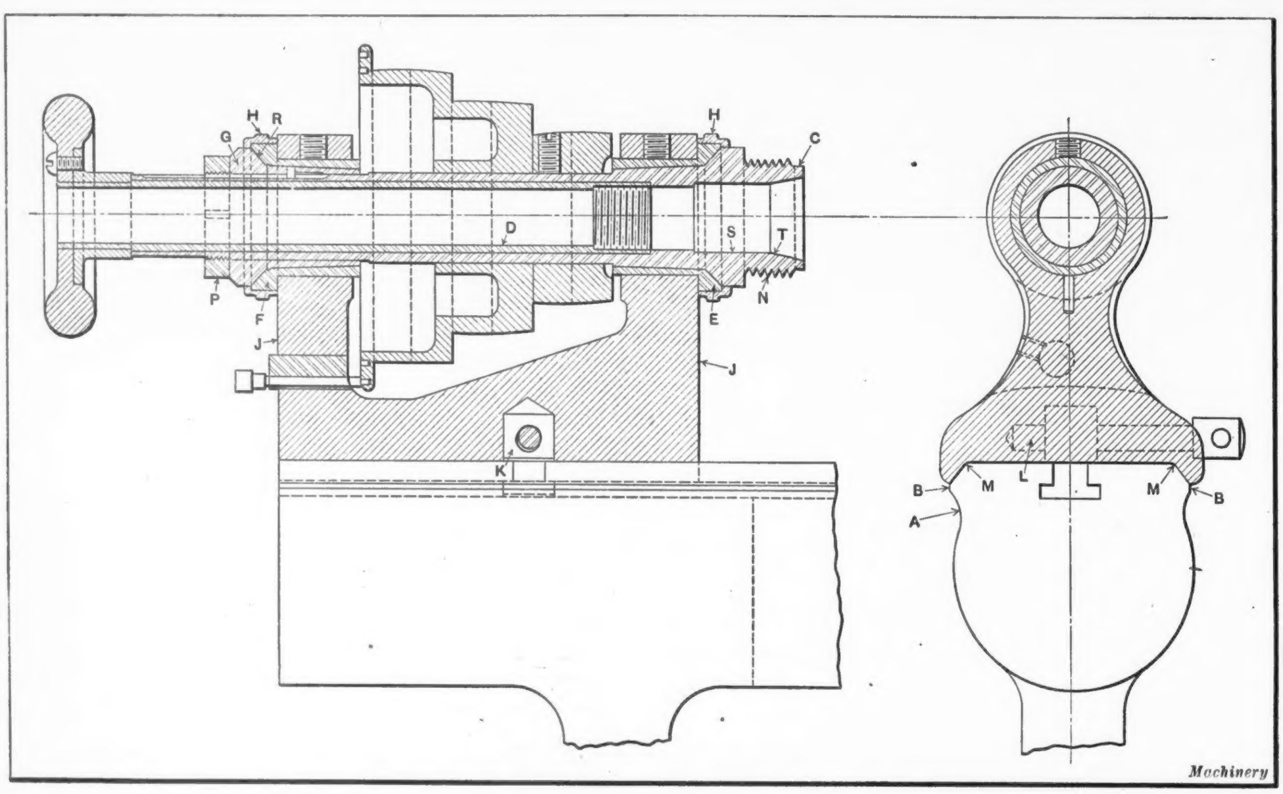


Fig. 1. Sectional View of the Assembled Headstock, showing Relation of the Various Parts

tools is almost generally followed. In Fig. 2, the set-up of a Brown & Sharpe milling machine is shown, in which a gang of seven cutters is employed to mill the top bearing surfaces for the headstock and tailstock, and the straight sides of the T-slot in the bed (see Fig. 1). The gang consists of two side milling cutters for surfaces *B;* two angle cutters for the angular surfaces; two face cutters for the top bearing surface; and one side milling cutter for the slot. The cutters and arbor form an assembled tool which is always kept intact for this job.

The casting is supported on the ends by V-blocks *A*, Fig. 2, located outside of the legs, and two slotted clamps *B* are employed to secure the work to the table. The slotting of the clamps permits the work to be quickly released or clamped in place. Rigidity in holding the work is much more vital in the case of milling operations than it is in planing, and this is suitably cared for in the present case. The practice of milling rather than planing is also a means of increasing the production rate of this preliminary machining operation. The production time, floor to floor, is twelve minutes per casting.

Inasmuch as the T-slot in the bed must be accurately located with respect to the top finished surface, this surface is used for locating the work during the T-slotting operation. Two angle-plates *A*, Fig. 4, attached to the milling machine table, are machined with elongated slots *B* of sufficient width to permit the passage of the T-cutter, and of sufficient length so that the work may be clamped to the angle-plates and at the same time leave an opening sufficient to allow clearance for the cutter at the beginning and end of the cut. The rate of production is one casting every eight minutes.

The grinding operation is not in itself especially interesting, but the substitution of this method for scraping the bearing surfaces is a distinctly novel feature in lathe manufacture. The grinding operation is performed on the Pratt & Whitney vertical surface grinding machine illustrated in Fig. 5. With this set-up, the angular surfaces of the bed are ground. Grinding, as a means of finishing these surfaces, may be criticized on the ground that there is a likelihood of the lathe bed being charged with abrasive, like a lap, and such a condition would be a decidedly undesirable one. This, however, has not proved to be the case, for the effect of the coarse wheel used is not analogous to that of the fine flour emery employed in charging a lap, and it has been found that the coarse abrasive of the wheel used has a tendency to fly off the surfaces rather than to embed itself in them. It requires thirty minutes to perform this grinding operation, including loading and unloading the work.

Another advantage derived from the employment of this means of finishing is the time saved over the scraping method and the subsequent economy realized. The human element also enters into the question, as operators are more averse to performing scraping operations than they are to operating a grinding machine. Scraping is a tedious job, and the results are not, to say the least, better than those realized by grinding. Referring to the illustration, it will be seen that these angular surfaces are ground to gage limits. In inspecting the surfaces of the work, a finished seat on the fixture is the registry surface employed. The accuracy of these surfaces is of vital importance, for by means of them the headstock and tailstock, and all other parts mounted on the bed are fitted.

The composite bearing surfaces of the bed are reproduced on master gage-blocks, and a quantity of these is always kept in stock for use in connection with jigs and fixtures employed during subsequent operations on the headstocks and tailstocks. By using these duplicate master locating blocks, the problem of establishing interchangeable manufacturing conditions is greatly reduced, since all fitted parts of the lathe bed are located from a common composite surface. However, this fact does not eliminate the inspection methods, which are fully as complete as would be the case if other means of locating were employed.

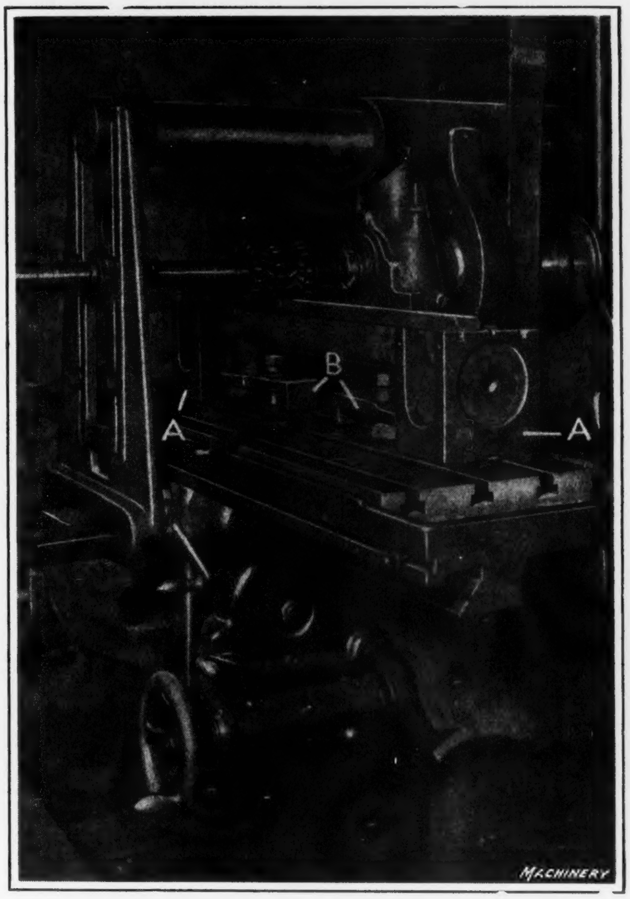


Fig. 2. Set-up for milling the Top Bearing Surface of the Lathe Bed

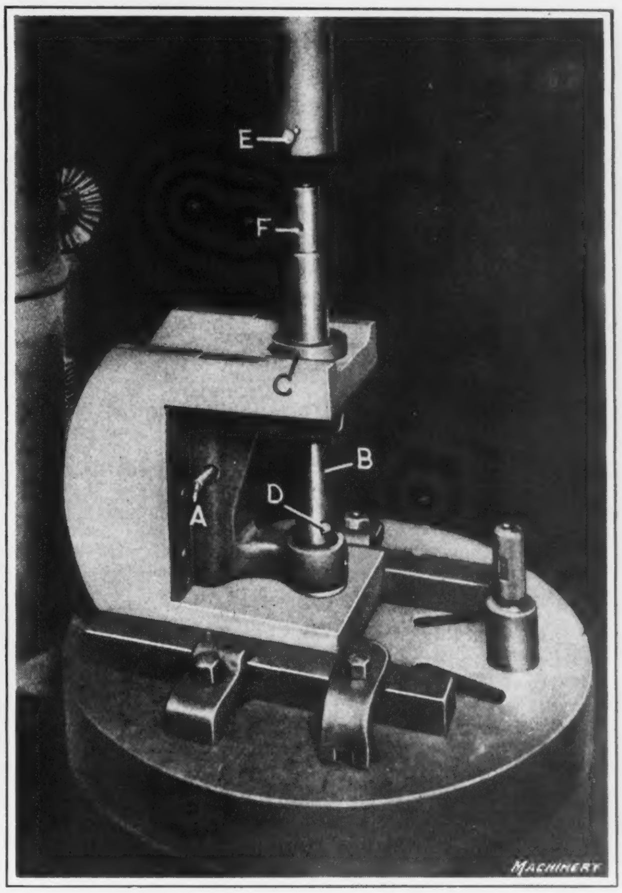


Fig. 3. Fixture used in boring the Bearing Holes in the Headstock Casting

Machining the Headstock

The headstock casting is the unit that establishes the degree of accuracy of the lathe, not only in regard to the fit on the lathe bed, but also in regard to the machining of the spindle bearing holes and the maintenance of perfect parallelism between the spindle and the lathe bed. In the longitudinal section through the headstock, Fig. 1, *C* is the spindle; *D* the draw-in sleeve, in the threaded end of which the spring collet is screwed; *E* and *F* the front and rear spindle bearings, respectively; and *G* the cone for the rear bearing. The draw-in sleeve is operated by a handwheel at the end, and the spindle bearings are protected by brass caps *H* against the entrance of all foreign material.

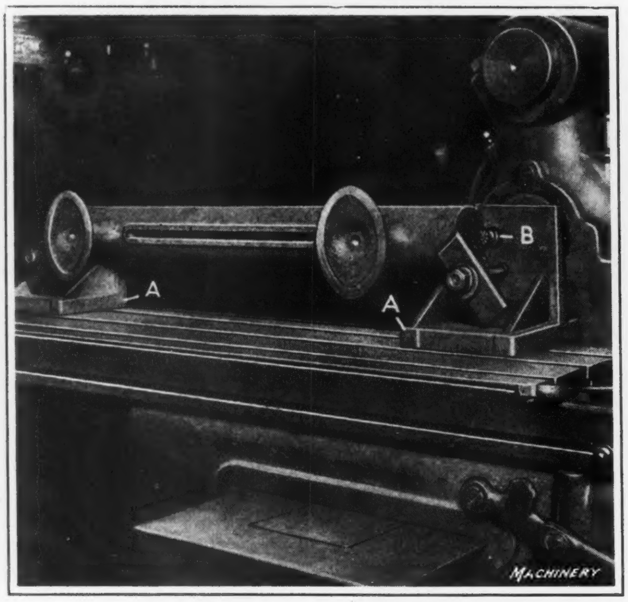


Fig. 4. Work located from the Previously Finished Top Surface and clamped to Two Angle-plates for T-slotting Operation

The operations required in machining this casting are as follows: Rough-mill the bearing surfaces of the base; face-mill the ends *J;* straddle-mill the inside of the spindle bearing hubs; finish-mill the bearing surfaces of the base; bore holes *K* and *L* for the locking cam and binder bolt; scrape, rough- and finish-bore the spindle hole; line-ream the spindle hole; and grind the ends. For the milling operations on the base of the casting, the work is mounted in an inverted position on the table of a No. 2½ heavy-duty Le Blond milling machine, as shown in Fig. 6; this illustration shows the finish-milling operation and the gage *A* used in connection with this operation. The work is held by means of a V-fixture, as the surface of the casting is sufficiently uniform for use as a locating point.

Three cutters are employed on this operation, one wide face-milling cutter *B* and two angle cutters *C* of slightly greater diameter than the facing cutter. This provides the required under-cut at points *M*, Fig. 1, for subsequently finishing these bearing surfaces. The remaining milling operations are performed with the work located on this finish-milled surface by means of master blocks, as mentioned in an earlier paragraph and as clearly shown in Fig. 7 at *A*. The production time for finish-milling the headstock base is eight minutes, floor to floor.

In milling the ends, two fixtures are used, enabling the operator to load one while the cut on the other is being taken. An inserted-tooth face-milling cutter is employed as shown in Fig. 7. It will be seen that the simple method of locating the work consists of a master block *A* with a tongue, indicated at *B* fitting the table slots, and a stop *C*. This machine is of the same make as that employed in the previous illustration, and the time required is two minutes per casting. The operation of milling the inside of the hubs is simply a straddle-milling operation. The grinding of the ends of the casting is done on a Pratt & Whitney vertical grinder, with the work located on hardened and ground master blocks, such as employed in milling the ends.

The binder bolt hole *K*, Fig. 1, through the base of the casting, and the hole *L* for the locking cam by means of which it is secured on the lathe bed, are next bored. These holes are later employed for holding the casting during the boring operation on the spindle hole. The bearing surface is next scraped, sufficient metal for which was left in the finish-milling operation by undercutting the angular sides of the fitting surface. Obviously, the bearing surface cannot be ground in this case owing to the angle, for it will be at once evident that the wear of a special grinding wheel on the edge would result in producing inaccuracies which would require correcting by scraping. Furthermore, the surface is a short one and can be scraped much more satisfactorily than could the long bed surface.

Fig. 3 shows a Sibley drilling machine and the jig used in the finish-boring operation of the spindle bearing holes. These holes are cored and are first rough-bored, using a counterbore and plain fixture, after which they are located in the fixture shown in the illustration. As in previous operations, the work is located in the fixture on a master block and is secured by a clamping bolt extending through the jig from the rear and entering the regular binder bolt hole *K*, Fig. 1. Pin *A*, Fig. 3, is inserted in the regular locking cam hole, passing through a hole in the clamping bolt, so that when the bolt is tightened, the casting is firmly held in place. This is the identical method by which the headstock is secured to the lathe bed, as was stated in the previous paragraph. The method of performing the boring operation is of interest.

An ordinary boring-bar *B* is used, but on account of the distance between the front and rear spindle bearings of the headstock casting and the necessity of using a pilot for the boring operation, it requires, according to the usual method of drilling machine operation, a movement of about 14 inches for the drilling machine spindle. As this is not possible, the hole is finish-bored by inserting the boring-bar in the hole of the jig in which bushing *C* is a fit, until the cutter *D* contacts with the casting. The taper shank of the boring-bar is drilled through as shown at *F*, for a driving pin, and the spindle sleeve of the machine is correspondingly drilled so that the jig may be slid under the spindle, which is then lowered to encompass the projecting shank of the boring-bar, and the driving pin *E* inserted. As the boring proceeds, bushing *C* will, of course, slip down into the fixed bushing and form a guide.

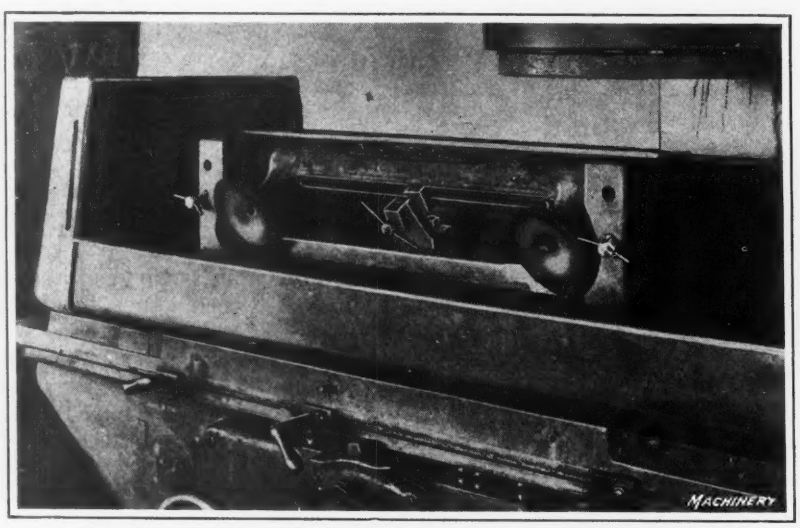


Fig. 5. Grinding the Angular Surface of the Lathe Bed on a Vertical Surface Grinder

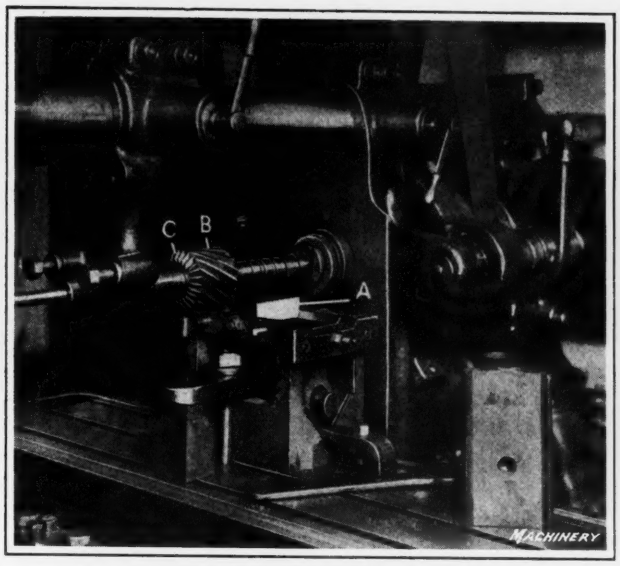


Fig. 6. Milling Bottom Surface of Headstock Casting

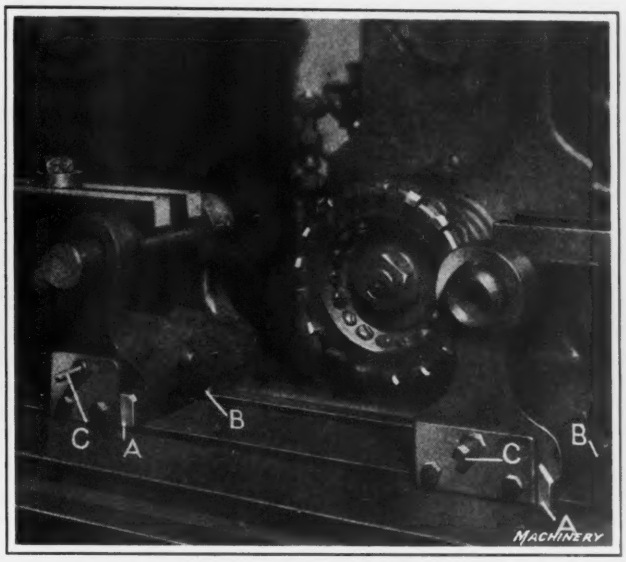


Fig. 7. Face-milling the Ends of the Headstock Castings

By this means, the accuracy of the drilling machine table is not depended upon to finish the hole parallel with the base, and by this method the desired accuracy in the hole is obtained. The connection of the shank and spindle provides a floating movement of approximately 1/32 inch between the boring-bar and the spindle center so that the boring-bar may be thrown out of alignment without destroying the relation of the hole to the base of the casting. In other words, the drilling machine spindle simply transmits power to the boring-bar without regard to the condition of the machine. This fixture and method are also employed in finish-boring the tailstock casting. The holes in the headstock and tailstock after being finish-bored, are line-reamed by hand, using a long pilot reamer. No tolerance is provided in machining these holes, since the goal strived for is absolute precision. In a later paragraph more will be said in this connection. The floor-to-floor production time for rough-boring is five minutes; for finish-boring ten minutes.

Carburizing and Casehardening

The vital parts of the headstock, in addition to the casting, are the two spindle bearings *E* and *F*, Fig. 1, the taper cone *G* for the rear bearing, the spring collet chuck, and the spindle *C*. These parts are all made of 0.25 per cent carbon machine steel, carburized and casehardened. There is no alloy or tool steel used in the manufacture of the Potter lathe, and this is regarded as rather unusual. It has been found, however, that with a soft core and a glass-hard case, the particular service required of the spindle and related parts is more satisfactorily met than would be the case if a material, such as tool steel, were employed. In addition to this, the expense is materially less and the length of service at least equal to that of the more expensive steel.

Another economical factor in this connection relates to the carburizing equipment. Instead of using cast-iron or steel carburizing pots or any of the specially manufactured alloy steel receptacles, a pot made of 3/8-inch thick boiler plate is used. Five pieces of this plate are welded together in the form of a box, and by this means it is possible to obtain pots of a suitable size and shape which can be made up in a very short time. The plates are welded, and usually twenty-four hours is sufficient notice for the welder to produce the pots on time. The cost of boiler plate is about 5 cents a pound, from which it will be seen that these boxes can be made economically, there being no other expense except the cost of welding. The cost of patterns necessary in the production of cast pots is of course eliminated, and as compared with cast iron, the boiler plate is superior in that the boxes do not warp. The cost of the pots is about 20 per cent more than that of cast-iron pots, but it is stated that the boiler-plate pots have double the life of the cast-iron pots and last about the same length of time as the cast-steel pots. A commercial carburizing material is used to pack the spindles and other machine-steel parts, and a temperature of 1600 degrees F. is maintained for a period of ten hours.

Before carburizing, the spindles are roughed out on a Jones & Lamson turret lathe and rough-turned and bored, leaving 0.015 inch stock for grinding purposes, this allowance being also left for grinding the threads at the nose end of the spindle. After the spindles have been carburized, the nose end is hardened, being heated to from 1350 to 1400 degrees F., back to about one inch beyond the front bearing surface. (See Fig. 1.) The rear end of the spindle remains soft, since this end fits into a casehardened cone *G* and this cone forms the rear spindle bearing. Prior to the grinding operations, a file and scleroscope hardness test is conducted, and then two center plugs are inserted in the ends of the spindle, these being a very light drive fit in the bore. The center plugs are not removed from the spindle until after all the grinding operations on the exterior have been completed. This prevents inaccuracies due to changing the relation between the center line of the work and the ground surface during the grinding operations.

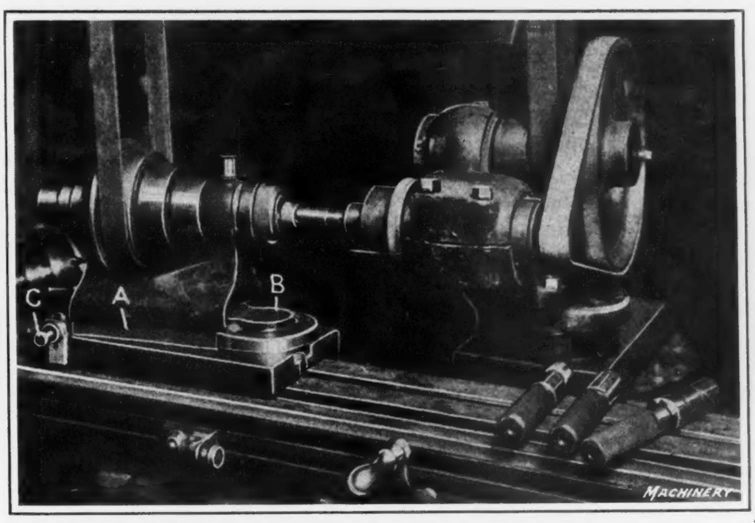


Fig. 8. Grinding the Spindle Bore and producing a Bearing Surface for the Collet Chuck

Machining Operations on the Lathe Spindle

The grinding operations on the spindle exterior are performed according to regular shop practice, but the finish-grinding operation does not complete the out-

side of the spindle, for that surface where the front bearing is assembled is required to be hand-stoned in order to obtain the desired bearing surface. This operation, which is also performed on the cone for the rear spindle bearing, is accomplished by testing with Prussian blue and then removing whatever minor surface irregularities may have been left by the grinding operation. The stoning operation is performed with the cone assembled on the spindle, and after the fitting is finished, the spindle and cone remain as one unit. This unit, together with the two bearings in which the spindle was mounted during the stoning operation, becomes the permanent combination of parts with which the lathe is to be equipped. Although these unit assemblies of the spindle are interchangeable in a broad sense, this stoning operation is performed in order to secure the highest running condition of the spindle. This is a minor operation as regards effort to secure perfect fit, but is of utmost importance for a precision tool running at 2800 revolutions per minute.

At the completion of the next two operations, grinding the threads *N*, Fig. 1, on the spindle nose and chasing the threads on the spindle for the adjusting nut *P*, the center plugs are removed from the spindle. The spindle is next assembled in its previously fitted bearings in the headstock, preparatory to grinding the bore diameters, and is then mounted on a swiveling fixture attached to the table of a Fraser bore grinder, as illustrated in Fig. 8. The block *A* swivels at *B* and may be set against stop *C* and locked by a screw that extends through a radial slot at the rear of the block. In this operation the straight hole *S* and the taper *T* (Fig. 1) are ground to form a seat and fitting surface for the collet chuck. This is accomplished by first locking the swivel block at an angle for grinding the taper, and then swinging it in line with the spindle for the straight hole. Thus two operations are performed at one setting of the work, with the assurance that the surfaces will bear the correct relationship to each other. The time required to grind both surfaces, floor to floor, is twenty-five minutes per spindle. A 46-K Norton wheel is used and the sizes are held to "Go" and "Not Go" gage limits. The plug gages for this hole, as well as the chamber gage for the taper, are shown on the table of the grinder. Finally, the headstock is disassembled and cleaned to obviate the possibility of abrasive or other foreign matter being located in the bearings.

The concluding installment of this article, which will be published in the April number of MACHINERY, will describe the grinding of the spindle bearings, cone, and collet chuck, the machining and graduating operations on the index slide, and the painting and inspecting of the assembled lathes.

* * *

INDUSTRIAL DEVELOPMENT IN AUSTRALIA

The war stimulated industrial development in Australia to a remarkable degree. A great many new industries sprang up during the war, and new tariff regulations have been made to protect some of these industries. Among the more important are those making electrical materials, hardware of various kinds, and agricultural machinery. There has also been a considerable development of the extensive steel plants of the Broken Hill Proprietary Co., of Newcastle. This is now the leading manufacturing industry of Australia, being equipped for nail making, wire drawing, the making of galvanized and plain sheets and tin plate, the rolling of structural steels and plates for shipbuilding, rails, wire rod, etc. It has been announced that several large British manufacturing firms intend to erect plants in Australia to produce their goods there instead of exporting from England. The representative of one of the largest engineering firms in Great Britain has recently visited that country. This firm has at present a contract for the construction of three 15,000-ton vessels for the Australian Government, and it is believed that plans have been made for developing a shipbuilding industry in Australia, rather than having all Australian ships built in England.

INDUSTRIAL CONDITIONS IN SWEDEN

Special Correspondence to MACHINERY

Stockholm, February 10

The industrial conditions in Sweden are far from satisfactory. Practically all the factories are running on short time with a reduced number of workmen, and the general tone of business is not very optimistic. Most of the manufacturers do not expect conditions to be better for several months, and there is a possibility that there will be but little improvement even then. No one seems to be able to analyze the real trouble, but considers it simply part of the business depression existing at the present time all over the world.

There are only two factories, to the writer's knowledge, that are working full time. One of these is a small concern making a special machine for which a large order is on hand. The other is one of the large shipbuilding works where Diesel engines and a number of ships are being built. This company secured an order a long time ago for Diesel engines with a contract so worded that it cannot be cancelled, and in this way this concern will have work enough to keep it going for several months.

There is only one automobile building plant in Sweden, situated a few miles from Stockholm. The stock of this company was listed at 125 last September, but is now down to 30. This company is backed by one of the most powerful banks in Sweden. Measured by American standards this is not a large concern, the yearly output being only about 300 cars.

The De Laval Separator Co. is working only three days a week, and it is stated that a further reduction may have to be made. The two large ball bearing manufacturers in Gothenburg are working five days a week with prospects of further reduction in capacity. There is very little buying done and little prospects of any appreciable trade in the near future.

American manufacturers are at a distinct disadvantage in trying to do business in Sweden, both on account of the general conditions and on account of German competition. At the present time the Germans are able to deliver, which they were not capable of doing a few months ago. It is said that they are now fulfilling their contracts to satisfaction, and that the difference in price asked by them as compared with American prices is very great. A few weeks ago a Swedish manufacturer wanted to buy a three-spindle drilling machine. The price of a well-known American make was about 30,000 Swedish crowns in New York. A German firm had a very similar machine in stock in Hamburg, which was offered for 5000 Swedish crowns. The same firm offered steam hammers for 7500 crowns that cost about 20,000 crowns in the United States.

A few months ago German manufacturers were not filling the orders they took and hence lost a good deal of prestige, but they are now meeting their obligations and deliveries very well, so that there is little chance at present for American machine tools, particularly as long as the exchange situation remains where it is. The present high value of the dollar is about as effective a barrier to American business abroad as could be conceived.

Management problems are receiving considerable attention in Sweden at the present time. A special journal dealing with management known as "Northern Journal on Organization" is published in Stockholm, a recent issue of which contains translations of articles by Taylor on "High Wages and Low Labor Cost"; by Gantt on "Shop Management"; by Hathaway on "Scientific Management," and by a number of other American authorities on management. The European countries realize the necessity for closer attention to management problems and scientific methods of production in order to be able to hold their own in the world's trade.

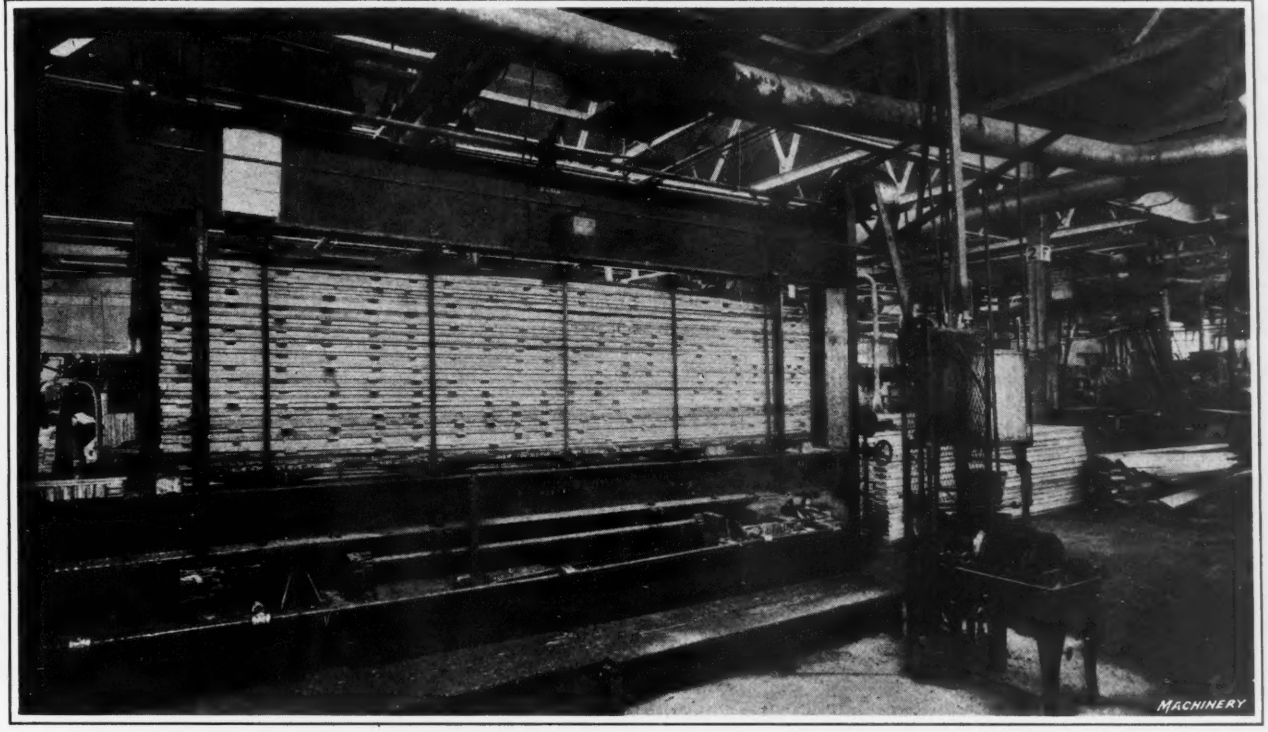


Fig. 1. Hydraulic Press which exerts a Pressure of Thirty-five Tons on a Stack of Sills after the Sections have been coated with Glue

Making Wooden Sills for Chassis Frames

Methods Employed in the Plant of the Franklin Mfg. Co., Syracuse, N. Y., for Producing the Wooden Side Members of Chassis Frames

THE construction of the chassis is one of the unusual features of the Franklin car, as the side members or sills are made of wood. These wooden sills are more expensive than those of pressed steel construction, but they are considered preferable for passenger cars. The advantages claimed for wooden sills are that they combine lightness with strength, and possess the property of absorbing shocks instead of transmitting them like steel. According to tests made at the Franklin plant, a chassis frame having wooden sills of approved construction is 65 per cent stronger than a steel frame of the same weight.

The first important step in the manufacture of these sills is selecting the wood. Second-growth white ash has proved to be most satisfactory, as it is strong but resilient and light. This wood is obtained chiefly from the Catskill Mountain region and from northern Pennsylvania. The lumber intended for the sills is air-dried or seasoned for at least six months and preferably for two or three years. As a result of this air-drying, most of the sap disappears and shrinkage takes place.

This air-dried material, after being sawed roughly to a shape, is placed in the dry kiln where it remains for about a week. This kiln is equipped with radiators and fans for circulating the heated air, and a temperature of about 130 degrees F. is automatically maintained. The lumber is sprayed with live steam during a period of about forty-eight hours, in order to cause the remaining sap to flow out through the pores of the wood. After this spraying period, the room is kept filled with steam during the remainder of the time that the lumber is in the kiln. This curing process is to prevent any twisting, warping, or checking of the wood after it is made up in a sill.

The sill is rectangular in cross-section, but it is not made of one solid piece, a laminated construction being superior. Fig. 2, which represents a cross-section, shows the three main strips that form the sill, and the thin strips at the top and bottom. The sections are carefully selected, not only to secure flawless material, but so that the grain of all three main sections lies in different directions.

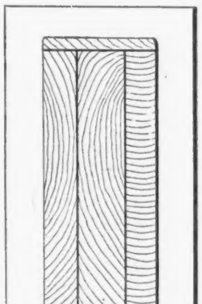


Fig. 2. Cross-section of Wood Sill for Chassis Frame

After the lumber is cured in the kiln, it is ready for planing and gluing. The planed surfaces of the sections to be joined are first covered with glue by a special machine consisting of a revolving brush which is supplied with glue as it rotates. When enough strips have been coated with glue to form a stack of seventeen sills, they are placed in a large hydraulic press, where they remain for one hour. This press, with a stack of sills in place, is shown in Fig. 1. The pile of sills is held together as one unit by the five clamps shown. These clamps are tightened while the hydraulic press is exerting a pressure of thirty-five tons on the sills, so that when the stack of sills is removed, they are still held together very tightly by the clamps. The sills remain in these clamps about twenty-four hours.

Band-sawing and shaping operations next follow, and the narrow "weather strips" are attached to the top and bottom to exclude all moisture from the joints. The sills are next planed to the thickness required, and then twenty screws are driven into each sill by means of a screw-setting machine in order to reinforce the three glued sections. A sanding machine is used to give the sills a smooth finish, and then after boring certain holes, cutting the sills to length, and shaping the front ends, they are ready to be assembled to the chassis.

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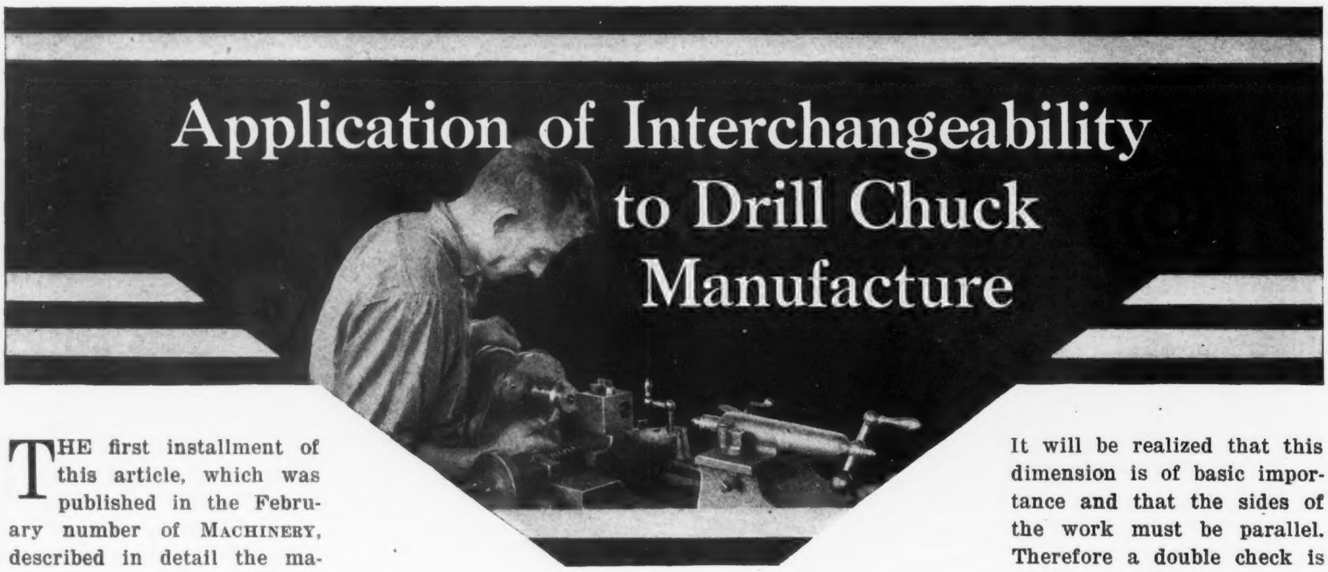
The American Welding Society has recently organized a section in Cleveland. Other sections of the society, which has its headquarters at 33 W. 29th St., New York City, are now in existence in New York, Pittsburg, Philadelphia, and Chicago.



Application of Interchangeability to Drill Chuck Manufacture

Second of Two Articles Describing the Tooling and Gaging Equipment Used by the Marvin and Casler Co., Canastota, N. Y., in Manufacturing the Casler Twin-screw Drill Chuck

THE first installment of this article, which was published in the February number of MACHINERY, described in detail the machining and gaging methods and the equipment used in the manufacture of the body, operating screws, and cap-plate of the Casler drill chuck. The present installment deals with the operations on the jaws, concluding with a description of the assembling and final truing up.

Preliminary Operations on the Chuck Jaws

With only minor exceptions, the right and left jaws are machined and gaged in the same way and are held to the same functional clearances. For that reason these two parts will be considered as one in describing their manufacture, except in instances where it is necessary to distinguish between corresponding operations on the mating jaws. The jaws are made from Midvale tool steel having a carbon content of 0.80 to 0.90 per cent. The stock is first inspected and cut into convenient lengths for handling, so that the preliminary rough-machining may be done before these short bars are cut into pieces of approximately the desired length for the jaws. The radius on the outer surface (see assembly view, Fig. 10) is then planed.

The bars are next cut into short lengths and are disk-ground on one side to furnish a locating surface from which to grind to thickness on a Blanchard grinder. This thickness A is held to within limits of $+0.000$ and -0.001 inch. It will be realized that this dimension is of basic importance and that the sides of the work must be parallel. Therefore a double check is taken to assure absolute accuracy with regard to this thickness, and in Fig. 12, "Go" and "Not Go" gages used are shown at A and B.

The blanks are then burred and returned to the Blanchard grinder where face B, Fig. 10, is ground for establishing a limit for dimension C of $+0.010$ and -0.000 inch. This operation is illustrated in Fig. 11, which shows a number of the blanks set upright on the table of the grinding machine and held in a vertical position by means of special parallels A. Obviously some such method of supporting the work in a vertical position is necessary, since the blanks rest on the curved surface that was planed in a previous operation. The snap gage used in connection with this operation may also be seen lying on the table of the machine.

Milling the Teeth on the Chuck Jaws

The next operation on the jaws is performed on a Kempsmith milling machine, equipped with a special arbor carrying eight cutters, and an indexing fixture having capacity for eight jaw blanks. This milling machine and its equipment is shown in Fig. 12, and the operation performed consists of milling the teeth in the jaw and straddle-milling the over-all length. An inspection of the illustration will make this obvious, and will also make it fully apparent that by em-

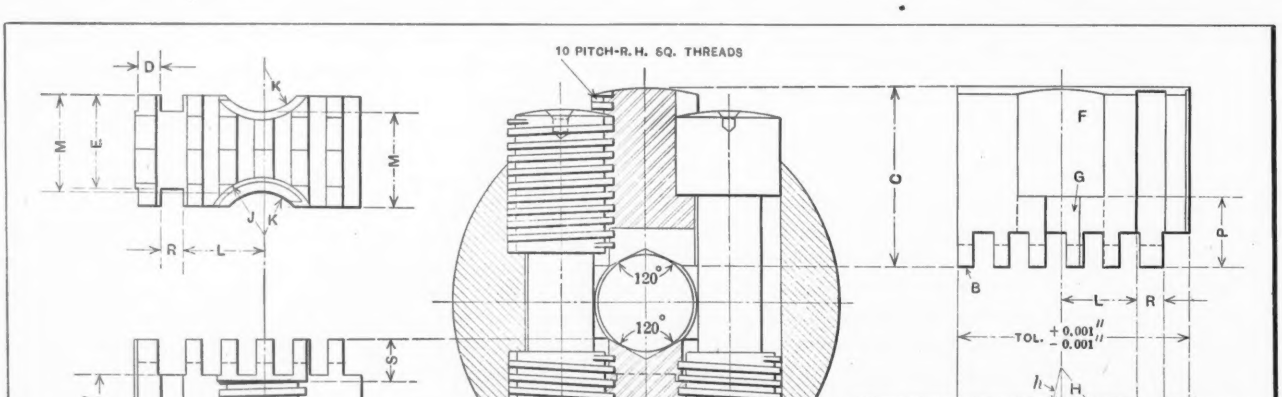


Fig. 10. Assembled Chuck, showing Relation of Parts, and Views of the Left- and Right-hand Jaws

ploying a permanent set of cutters and an arbor, the relationship between the gashes in the teeth and the parallel ends of the blanks can be kept uniform. It was stated in the preceding paragraph that a double check was taken on the thickness of the jaws; this is done by employing gages *A* and *B*, and the operator who has ample time for this purpose, attends to both the gaging and milling operations. The teeth are not cut in any jaw until it has satisfactorily passed this thickness test. Four jaws which have just been removed from one side of the milling fixture are shown on the machine table, from which the appearance of the work after the operation has been performed may be seen.

In describing the construction of the fixture and its method of operation, reference should be made to Fig. 13, which is a sectional view and partial plan view of the fixture. The position of the work is indicated by heavy dot-and-dash lines, showing that four pieces are loaded in each of the two stations of the milling fixture and clamped between jaws *A* and steel faces *B* by means of the clamping nuts *C*. When the nuts are released, coil springs interposed between the clamping jaws and the body of the fixture force the clamping jaws away from the work so that the pieces may be quickly and readily removed. The locking detent *D* may be operated by the eccentric cam-lever *E*, to withdraw it from the steel bushing *F* in the base of the fixture, so that the turret of the fixture may be revolved 180 degrees, and the detent inserted in a similar bushing on the opposite side of the fixture. The general idea incorporated in this fixture is not new, it being simply an adaptation of the quantity production idea of reducing the amount of idle time of machine and operator. The operator loads and unloads one station and checks the thickness of blanks to be loaded, while the four blanks in the operating station are being machined. The width of the teeth gashes and teeth themselves are not of vital importance to the interchangeability of the chuck parts.

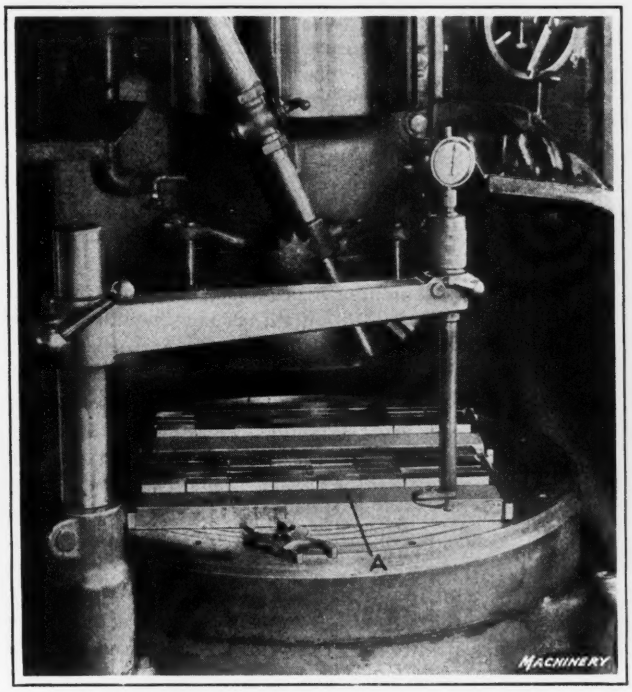


Fig. 11. Jaw Blanks ground to Width on Surface Grinder

Machining and Gaging the V-groove

The next operation consists of milling the 120-degree included angle in the tooth sections of the jaws (see sectional view, Fig. 10). This operation is performed on a Van Norman milling machine, and the fixture used is illustrated in Fig. 14, in which the work is located vertically on steel seats *A*. These strips are set into the cast-iron body of the fixture on each side, and extend the entire length, so that five blanks may be set up on each side and clamped in pairs by means of the bolts *B*. Attention is called to the liberal locating surface provided for the horizontal side of the blanks, which insures that the center of the V-grooves will be at right angles to the previously ground surface, a condition which is absolutely essential to assure perfect alignment for the drill shank with the center line of the drilling machine spindle when the chuck is in use.

The vee must be centrally located between the parallel sides, and must be of the proper depth to within limits of ± 0.005 inch. The depth of this vee is checked by employing a low-limit measuring wire and a high-limit measuring wire, which are laid in the V-groove with a flat block resting on the top surfaces of the teeth. The central location of the V-groove is held to within a tolerance of 0.001 inch, and the method of checking this is of considerable interest. A 3/8-inch diameter hardened and ground steel roll having a central hole in which a spring wire is assembled is used in checking this measurement. This wire is bent to a rectangular shape and the ends are welded together, so that when the roller is laid in the V-groove, the wire may be sprung over the curved outer surface of the jaw to hold the roller in the groove. The jaw is then laid flat on its side, resting on a surface plate, and a check block and Koch indicator are used to measure the height of the hardened steel roller from the surface plate and to determine its degree of parallelism.

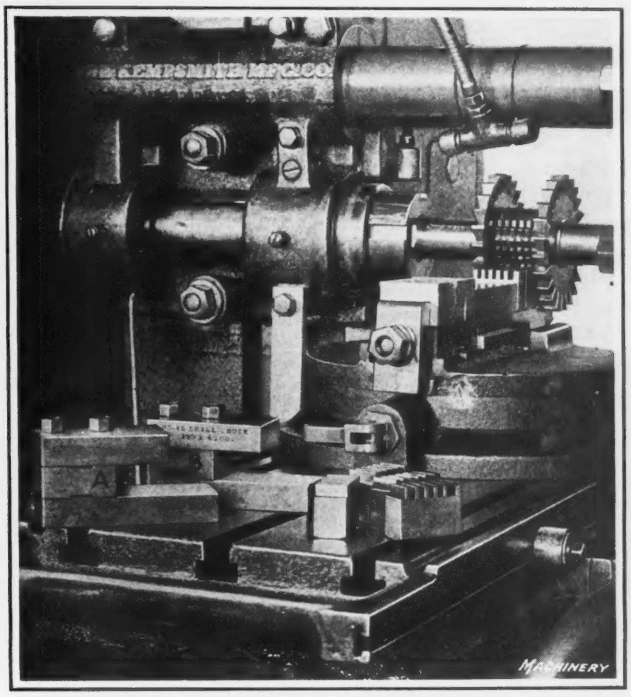


Fig. 12. Straddle-milling the Jaws and cutting the Teeth

Keyway Milling Fixture and Inspecting Equipment

The keyways in the sides of the jaws must be machined to extremely close limits, since these keyways or guides determine the degree of fit for the jaws and jaw gash in the body. The V-grooves having previously been machined centrally, and held to a tolerance of 0.001 inch can be advantageously used as registry points when clamping the jaws in the milling fixture in which they are held during the milling of these keyways. Fig. 15 shows a surface plate with the fixture used in this operation resting on it; also a collection of gages and a piece of work showing the keyway *P* milled in this operation.

The fixture has a capacity for four pieces, these being placed with the V-grooves engaging the double V-blocks *A*, abutting against the hardened steel locating buttons *B*, and resting on the hardened steel seats *C*. The clamping jaws *E* are so designed that they engage the curved outer surface of the jaws and exert a downward pressure when the work is clamped in position. The clamping straps *D*, which are

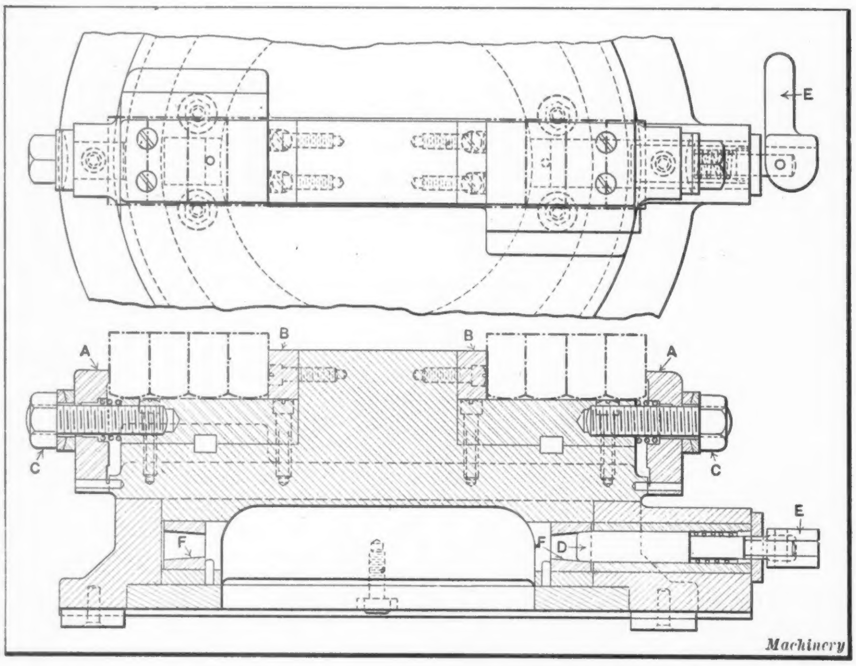


Fig. 13. Sectional and Partial Plan Views of the Milling Fixture illustrated in Fig. 12

employed to hold the work by exerting a pressure at right angles to that of jaws *E*, are provided with a pivoted evener jaw *F*, so that when this jaw is tightened the end pressure on each piece of work will be equal. There are two cutters *G* used on the arbor of the milling machine, so that at the same time that the keyways are milled a cut is taken on the end of the jaw to produce a shallow tongue which fits in a clearance space in the jaw gash (see surface *T*, Fig. 1, page 510, February number). In this straddle-milling operation, dimension *D*, Fig. 10, is held to limits of + 0.000 and — 0.001 inch.

Referring now to the set of gages in Fig. 15, it will be seen that gage *H* is a combination "Go" and "Not Go" gage for width *R* (Fig. 10) of the keyway, which has a limit of + 0.000 and — 0.001 inch; gages *J* and *K* are "Go" and "Not Go" gages, respectively, for the thickness *D* (Fig. 10) of the jaw guide; and gage *L* is a double-ended "Go" and "Not Go" gage for inspecting dimension *E* (Fig. 10), which is held to limits of + 0.000 and — 0.005 inch from each side of the jaw. That is, in using gage *L*, the work is located against the flat surface of the gage, first from one side and then from the other, both ends of the gage being used in the same manner. Gage *M* is a functional gage, containing a T-slot which is a duplicate of that in the chuck body. The jaws must slide smoothly through this functional gage, otherwise they are rejected until they can meet the requirements of this gage. Gage *N* tests the relation of the keyway to the parallel sides of the jaw and also in relation to each other; that is, the keyways must be directly opposite each other as well as parallel.

In describing the machining operations on the jaw body, particular emphasis was placed upon the accuracy of machining surfaces *L*, Fig. 1 (see page 510, February number), and at this time equal emphasis should be made in connection with the inspection of the jaw keyway, since it will be apparent that the upper surface of this keyway rides on surfaces *L* which are machined square with the sides of the jaw gash, just as the keyway is milled square in relation to the sides of the jaw. In other words, any slight discrepancy between these mating parts in this particular surface will impair the functioning of the chuck and destroy the interchangeability of its parts.

It will be realized that jaws having the peculiar shape of those used in this chuck present a condition which demands the utmost care in inspection work, as well as in machining operations, in order that the claims for interchangeability may be fulfilled. The fact that a combination of screw threads and irregular contact areas enters into the manufacturing problem is sufficient to introduce a condition which adds to the degree of precision which the jaw and body must have in their fitting.

Counterboring Thread and Screw Clearance Grooves

Both the left- and the right-hand jaws have clearance grooves on their sides for the body of the operating screws, and grooves for the threaded sections in which the operating screws function, as will be seen by referring to Fig. 10. These grooves are machined by counterboring, and the operations are performed on a specially equipped drilling machine, as shown in Fig. 16. For each set of jaws there are three jigs of the type shown at *A* used, but for the purpose of description the one illustrated will enable the features of all these jigs to be understood. Although the jigs themselves are of interesting construction, the special attachment used in connection with the jigs is of equal interest.

A special auxiliary spindle *B* provided with a flexible joint *C* is fitted to the spindle of the drilling machine and its lower end operates in a bronze bushing within the cast-iron bearing *D*. The jig is seated on a slide *E* which, in turn, rests on a cast-iron base clamped to the bottom of a deep oil-pan *F*. Handle *G* operates a lever and link mechanism by means of which the jig is advanced on the slide to a forward position when it is desired to load or unload the work. Special two-step counterbores such as shown at *H* enable the thread groove and the clearance for the operating screw to be counterbored at the same time. The jig holds two jaws, the counterbore passing down through the space between these jaws, but in the illustration one of these jaws is shown lifted from its proper position so that the counterbored surfaces and the method of securing the work in place may be seen.

The jaws fit accurately in the openings in the fixture which contain keys that fit the previously milled keyways in the jaw, and are pushed down until it is possible to insert the hardened steel plugs *J* in holes *K* of the jig, so that these

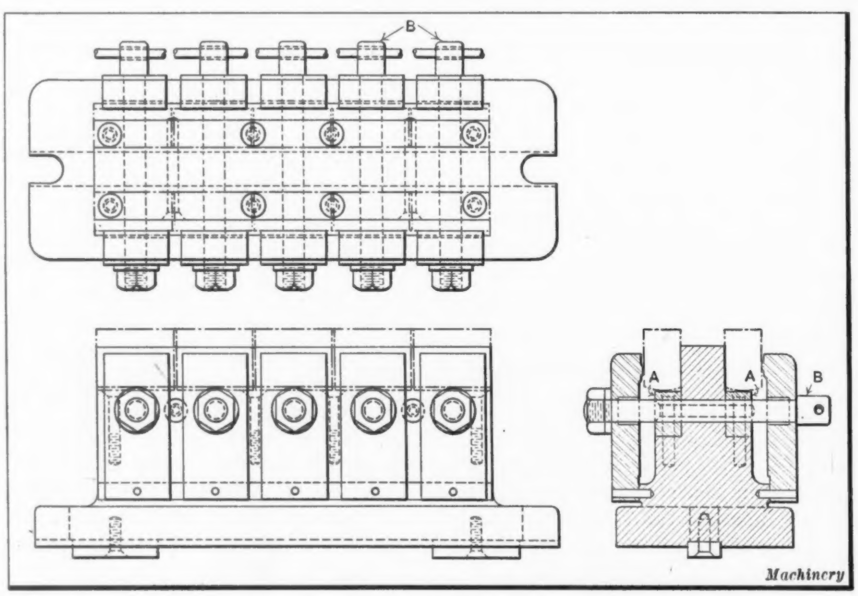


Fig. 14. Milling Fixture for milling the 120-degree V-grooves in the Teeth of the Jaws

plugs will engage the V-grooves in the top of the jaws. Thus, it will be seen that the keyways and the V-grooves, and not the length of the jaws, are in reality the surfaces from which these counterbores are located. When the jaws are pushed down, the curved end of the jaws is in contact with the extremities of the hardened steel fingers *L*, which fulcrum at *M* and bind the work against the hardened steel plugs *J* when the knurled-head screws *N* are tightened. The contact of these fingers is on the center line of the jaws, so that the pressure is properly applied. In operation, the work is constantly flooded with coolant which flows into the deep oil-pan especially provided to accommodate a copious supply of liquid. As previously stated, during the period of removing and replacing the work, the fixture is slid forward where the work can be conveniently done without interference with the cutter.

Referring to the two grooves *F* and *G* for the secondary screw (see Fig. 10), the limits allowed on the radii *H* and *h* are + 0.012 and — 0.000 inch. The thread clearance groove *J* on the opposite side of this jaw is of the same radius and has the same tolerance as both thread clearance grooves on the left-hand jaw. These grooves for the primary screw clearance are indicated by the same reference letter, and the limits allowed for these grooves are + 0.015 and — 0.000 inch. The radius *K* for both jaws is the radius of the surface in which the threads are subsequently cut, and this radius has the same tolerance as that allowed for radius *J*, that is, 0.015 inch. The length *S* of the screw clearance counterbore is held to very close limits, that is, + 0.000 and — 0.008 inch, and there is a limit of ± 0.005 inch for dimension *P* of the secondary screw.

It was previously mentioned that a key in the jig engages a keyway in the jaw as a means of locating the jaws for counterboring these surfaces. The limit on this dimension *L* for each jaw is ± 0.002 inch. Referring to the gaging equipment shown at *O*, Fig. 16, it will be obvious that gages of this type provide a "Go" and "Not Go" limit for the radii of the counterbored surfaces, and a similar means of inspecting dimensions *M*, *N*, and *O*, Fig. 10. In gaging, the jaws are simply laid on the block and brought under the hardened steel gaging members. The limits for dimensions *M* are — 0.001 and — 0.005 inch; for dimension *N*, + 0.009 and — 0.010 inch; and for dimension *O* ± 0.007 inch.

Special Hobbing Machine for Cutting Threads in the Jaws

The jaws have square threads of 1/10 inch pitch, and these are machined on a special hobbing machine illustrated in Fig. 17. The machine has two work-holding fixtures *A* in which the jaws *W* are located in a similar manner to the method followed in clamping the jaws in the previous operation, that is, by means of keys for the keyways and a steel plug for the V-groove. It will be seen that the fixtures are dovetailed to the work-head *B* so that they can be changed to provide for hobbing other sizes of jaws. Two jaws of the same hand are hobbed at one time, and a two-fluted hob *C* is employed for the purpose. The opposed work-heads are fed toward the hob by means of suitable gears, the power being delivered from the gear-shaft which passes through the machine and on the end of which the handle *D* is fitted.

A ratchet wheel *E* and a pawl *F*, are adjusted to give the proper amount of feed for the work-heads per hob revolution. Every thousandth inch of feed is represented by four ratchet teeth on the wheel, and by locating the handle *G* in the proper angular position, trip *H* will cause the mechanism to knock off when desired. The hob is intermittently thrust forward after each complete revolution, a distance equal to the pitch of the screw, or 1/10 inch. This sudden forward movement of the hob occurs between the time that the two rows of teeth, which are located on opposite sides of the hob, are passing from one jaw to the other. The two jaws are so placed in relation to the hob that the radial arcs of the counterbored surfaces would, if completed, form a full circle. This leaves an opening between the jaws sufficient to enable the hob to advance to bring its teeth forward 1/10 inch to the starting point.

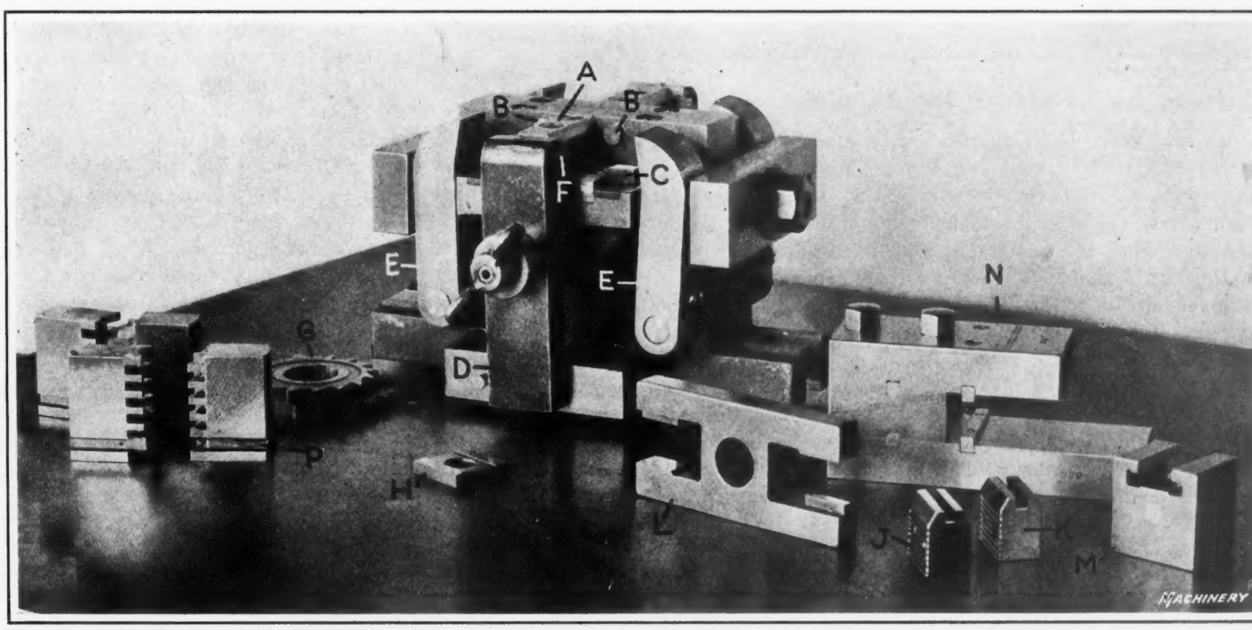


Fig. 15. Milling Fixture and Gages used for milling and inspecting the Keyways in the End of the Jaws

The backward traverse of the revolving hob, during which the cut is taken, is controlled by a cam and roller at the rear of the machine, and the sudden forward movement is governed by spring action, the spring being located at the end *S* of the spindle so as to operate as soon as the contour of the cam permits. The feed per spindle revolution is obtained by a cam, carried inside the driving pulley, in contact with which a roller operates. This roller is carried on arm *J*, which is thus swung backward and forward. The throw of the pawl *F*, and consequently the number of teeth taken up by the feed-pawl, may be regulated by means of the knurled adjusting screw *K*. The two shoulder plugs *L* in the work-heads enable the position of the fixtures to be adjusted as may be necessary to correct any errors in the threads which show up during the inspection of the first pair of jaws hobbed in any particular lot.

The gaging equipment used for testing the threads is of an interesting nature. There is a master block *M* in which a master screw is fitted, which is operated by a knurled knob. The block has a floating roller *N* against which the jaws, after being laid on the block, are drawn by means of

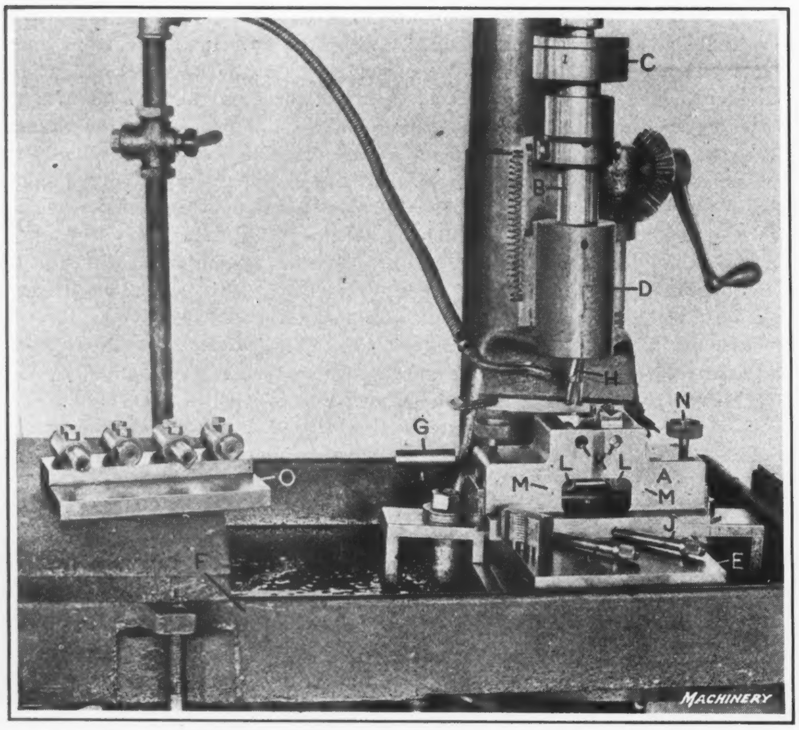


Fig. 16. Drilling Machine and Two-station Jig used for Counterboring Operations

the master screw. The floating roller contacts with the V-groove while the threaded jaw and master screw are in engagement, the flat side of the jaw resting on the flat surface of the block. This is the identical relation of contact surfaces that exists in the finished chuck; in other words, this is a functional gage. The collar *O* of the master screw and the upper surface of the master block are so graduated that when the limits have been established these two lines will coincide. A limit snap gage *P* of special design is used in conjunction with hardened and ground master screws *R* which fit the threads in the jaws, as shown in the illustration. Then the jaw, with the master screw in engagement with the threads, is slid under the gaging points so that the limits for depth of thread may be carefully and accurately checked.

It is impossible to give any limits for establishing the dimensions between the V-groove and the threads, but for the depth of the threads the hob is held within limits on the radius of + 0.002 and — 0.000 inch. Between the thread grooves and the outside diameter of the operating screw there is a basic clearance of 0.005 inch. After hobbing, the curved ends of the jaws are ground and polished, before being finally subjected to heat-treatment. The jaws are hardened at a temperature of 1425 degrees F., and are quenched in oil, after which they are drawn in oil for a period of thirty minutes at a temperature of 310 degrees F. They are finally wire-brushed to remove the oxide scale and clean the surfaces preliminary to the final inspection before being assembled in the chuck body.

Assembling and Final Truing-up Operations

In assembling the chuck, the body is held in a bench vise with special jaws, as shown in Fig. 18, and the primary screw is forced in so that its neck fits tightly in the recess provided for it in the body. Then by employing a long brake-lever to hold the screw in place, it is worked by means of a suitable crank which fits in the wrench socket, until the shoulders of the recess become rubbed down or burnished and the screw operates freely. The cap-plate is then assembled and the primary screw removed. The jaws are next forced into the body by means of a foot press shown at the left in Fig. 18. The body is then located in the special fixture *A*, mounted on a shaper table, and the jaws worked to a functional fit by a special connection to the ram of the shaper. In place of the regular tool-head, a special arm *B* is attached to reciprocate the three rods *C* through the fixture. Two of these are guides and the middle one is the means provided for working the jaws back and forth in the body.

While this machine is in operation, the assembler is engaged in reassembling the primary screw with the two jaws in the body just removed from this fixture, and in preparing the next body for the arbor press by driving two jaws partly into the gash by means of a wooden mallet. Then with the primary screw that was first fitted in the body and the two jaws that were worked to a functional fit in the jaw gash, assembled, the chuck is passed along and is hand-fitted and the secondary screw assembled. There is no fitting necessary in assembling the secondary screw. This completes the assembling, and the chuck is then tested for torque on the screw and jaw threads by applying a 75-pound leverage pressure to them.

The assembled chuck is then placed on an arbor, on which it is secured by means of its own jaws, and the small diameter of the body trued up. The next operation is that of rough-taper-boring the shank hole on a Porter-Cable lathe. After the hole has been rough-taper-bored, the chuck is disassembled leaving the cap-plate in place, the jaws and screws being kept together and filed in pigeon holes, as shown in Fig. 6, page 513 of the February installment. These pigeon holes are numbered to correspond with the number of the chuck which is stenciled on the outside of the body. The body and the assembled cap are then fitted to a tapered arbor by means of the rough-bored tapered hole; and the central hole in the plate through which the drill extends when the chuck is in use is bored concentric with the shank hole. In case the outside diameter of the assembled cap does not conform to the outside diameter of the chuck body, a light cut is taken to true up these diameters. The outside diameter of the body and cap-plate is then ground for finish, stenciled with the maker's name, and returned to be reassembled.

With the jaws and screws reassembled in the chuck body the tapered shank hole is rebored on a Reed-Prentice 10-inch

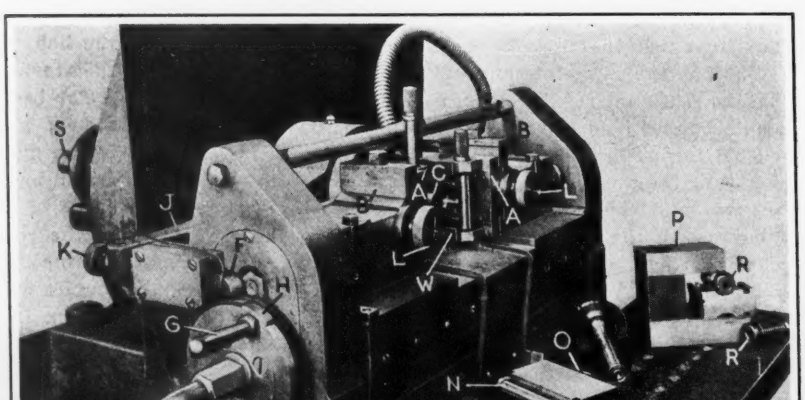


Fig. 17. Single-purpose Jaw Hobbing Machine with Two Dovetailed Work-heads

lathe equipped with a taper attachment, which consists of a bar having a taper surface operating in a block at the front of the cross-slide. This set-up is shown in the heading illustration in which the projecting end of this bar may be seen. The angular traverse of the single-point boring tool employed in this operation is accomplished by a finger on the slide-screw which engages the tapered surface of the bar. The lathe is equipped with a special faceplate, which has a stud over which the chuck is slid and held by means of the regular chuck jaws.

The concentricity of the tapered hole and the chuck is then tested by fitting a long tapered plug into the shank hole, this plug being hardened and ground and extending 6 inches beyond the end of the chuck. Then by employing a Koch indicator to engage the extremity of this plug, the running truth of the chuck may be readily tested. With the point of the indicator at a distance of 6 inches from the end of the chuck, it cannot fluctuate more than 0.006 inch and still pass final inspection. This completes the manufacturing processes in which the factors of accuracy and interchangeability enter. The wrench provided for the chuck is made of 3½ per cent nickel steel, and is properly heat-treated and quenched in No. 2 Houghton quenching oil.

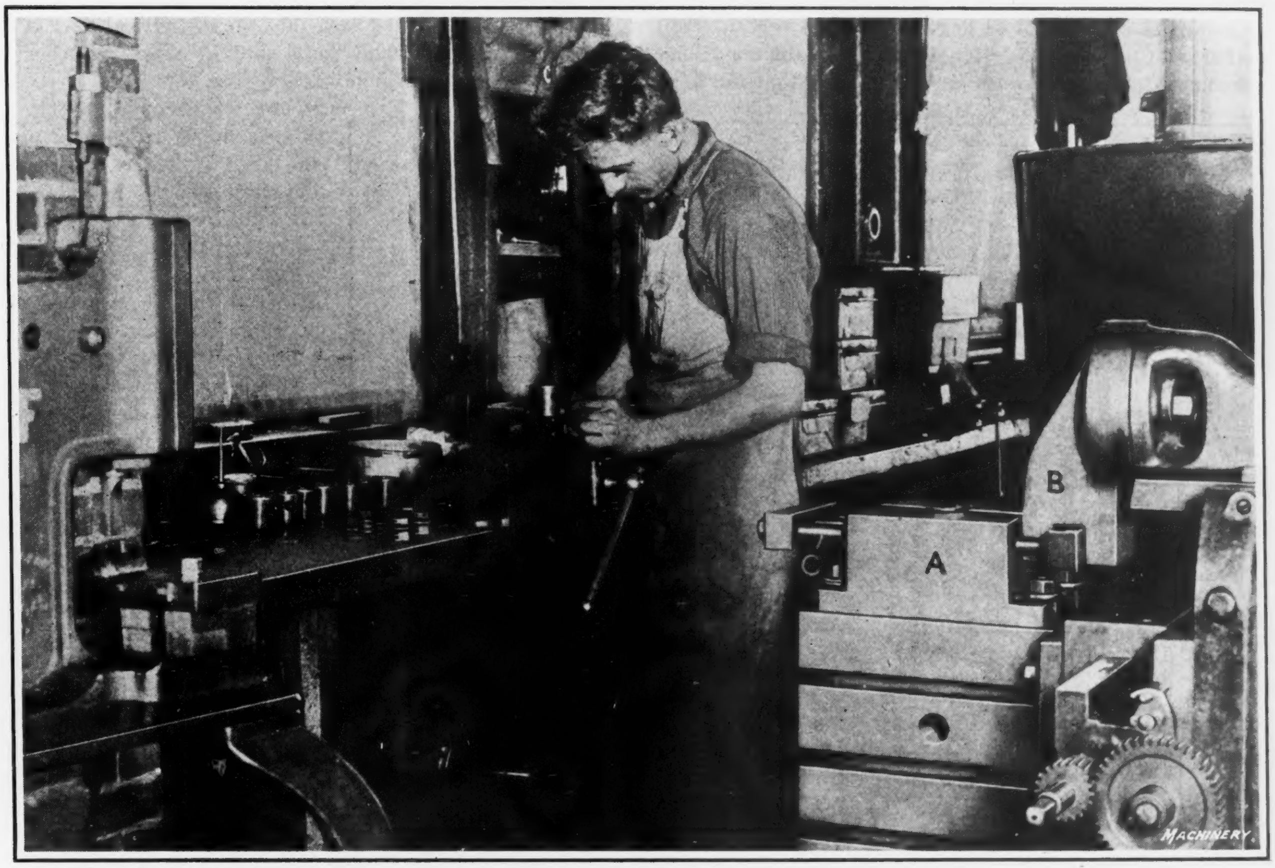


Fig. 18. Equipment employed in assembling the Drill Chuck including Bench Vise, Foot Press, and Specially Equipped Shaper

* * *

NOVEL METHOD OF TRANSPORTATION

A company known as the Road-Rail Loco-Tractors Ltd. has been formed in England for developing a novel system of transportation in rural districts and on tea, sugar, and rubber plantations. In this system, a rubber-tired tractor draws a train of cars, the tractor running on a prepared road track outside of two rails set to a narrow gage on which the cars run. This scheme was utilized in East Africa during the war to overcome the transportation difficulties met with in that rough uneven country. It is stated that the tractive effort of a rubber-tired vehicle on a road is double that of a locomotive on rails, while the resistance of cars running on rails is only about one-half that of vehicles running on a road; thus a double advantage is gained.

FUELS FOR MELTING BRASS

A recent number of *Graphite* contained an article discussing the merits of the various fuels used in melting brass, in which it was stated that the best fuel for this purpose is that which will give the best quality product for the least manufacturing cost, and that the cost per pound of brass melted should be the basis upon which the fuel cost should be considered. The available fuels used for melting brass are: Coal, coke, fuel oil, city gas, producer gas, water gas and various similar types of manufactured gas, and natural gas. Most of the brass produced in this country is melted by the use of coal and coke. The results obtained are satisfactory so far as flexibility, reliability, and quality of the product are concerned. For a small installation, and for small heats of special mixtures, where great flexibility is required, coal and coke fires are most satisfactory and inexpensive. The investment required in coal or coke brass-melting furnaces is less than for any other. Oil is an easy fuel to handle, but at present it is expensive and hard to obtain, and the rate of consumption indicates a greater future scarcity and much higher prices.

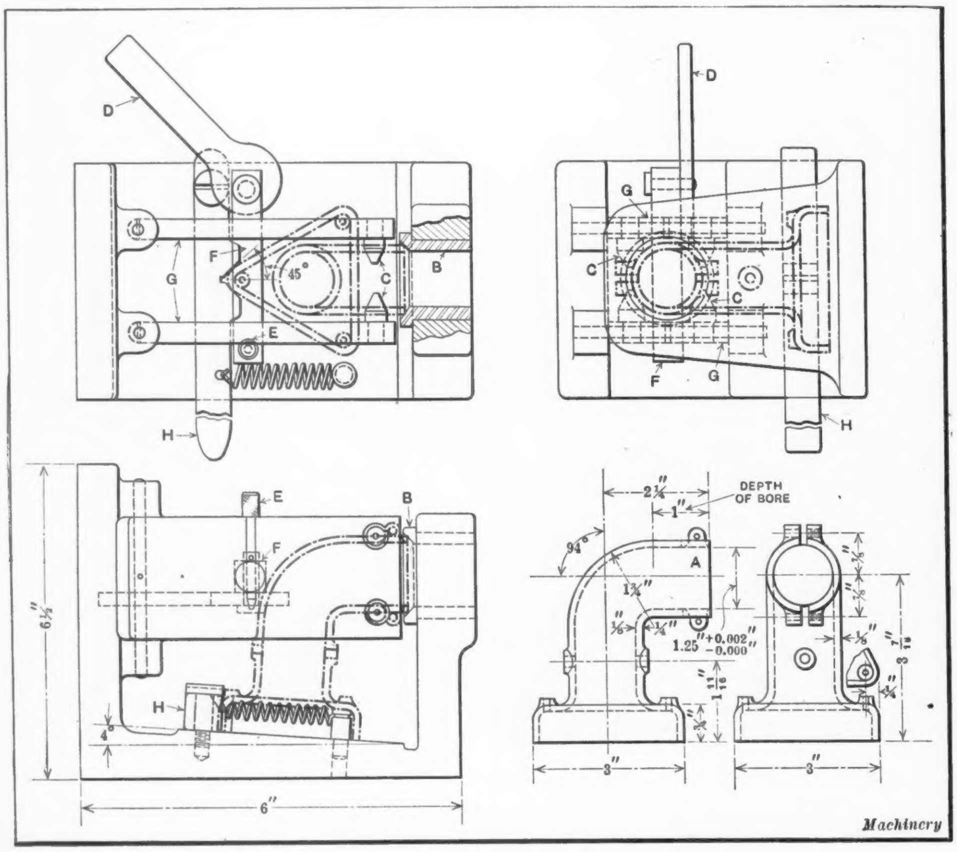
City gas is no more expensive than coal or coke, if all factors are considered, among which the following are the most important: First, less labor is required to operate gas furnaces; second, the crucibles have a longer life; and third, there are no ashes to handle or treat. These factors are true for all types of gas fuel used in crucible furnaces. In the case of gas, the difference in the price of fuel is more than counterbalanced by the great saving possible in labor and ash-treating, and by the greater speed in melting.

Manufactured gas can be used to great advantage in crucible melting, and by many it is regarded as much more satisfactory than either oil or natural gas because of the lesser tendency to oxidize the carbon in the pots. Another factor to be considered in connection with the use of gas in crucible brass-melting is the fact that the same gas can be used profitably in annealing and heat-treating furnaces in the same plant.

Jig with Cam-actuated Clamping Arrangement

By W. BURR BENNETT, President, Wayne Engineering Co., Honesdale, Pa.

A JIG which embodies in its design clamping and locating arrangements of an unusual nature is shown in the accompanying illustration. This jig was designed for locating and holding an aluminum part known as a carburetor hot-air intake, which is shown in the lower right-hand corner of the illustration. The machining operation performed in the jig is that of boring the 1.25-inch hole *A* to a depth of 1 inch. It will be seen that the center line of this hole is at an angle of 94 degrees with the vertical; this, together with the general design of the part, calls for a somewhat unusual holding means. It is necessary that the bored hole be concentric with the outside diameter of the end in which it is bored.



Detail of Carburetor Intake, and Jig in which it is held when boring Hole

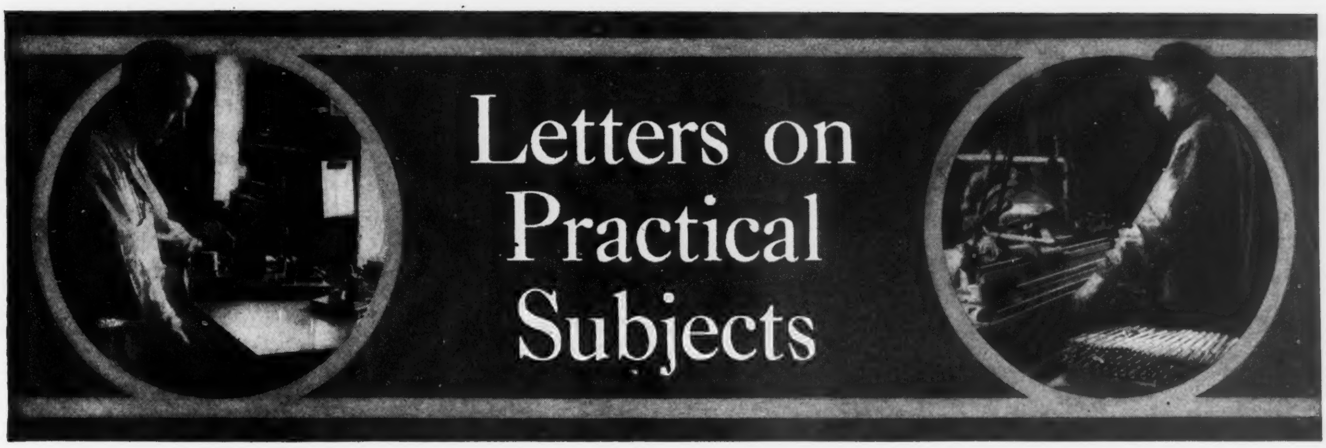
In the illustration of the jig the position of the work is shown in heavy dot-and-dash lines. The base of the part, which is triangular in shape, is seated on its previously ground surface, at an angle of 4 degrees. In this position it is held by spring tension, with the L-section in which the hole is bored located concentrically in the cupped bushing *B*. The support for this part of the casting consists of four conical-head guide pins *C* which are brought into contact with the outside of the work in the relative position shown in the side elevation. The arrangement whereby these pins hold the work allows for variations in the diameter of the casting so that after it has been located in a concentric position against the angular surface of bushing *B*, it may be securely held in place.

The jig is operated and the work located in it in the following manner: After the boring operation has been performed and it is desired to remove the work from the jig, release the cam-lever *D*, withdraw the knurled-head pin *E* from the cam-rod *F*, thus releasing the hinged gates *G* in which the guide pins are carried. By depressing the tension bar *H*, the work may then be readily removed. It will be seen that the cam-rod *F* is of circular section except at the end to which the cam-lever *D* is attached, this being of square section. It will also be seen that the cylindrical part of this member extends through both gates *G* after the work has been located on its angular seat and the gates have been swung in place, so that it is a simple matter to drop in pin *E*, the head of which rests on the upper surface of the outer gate, and quickly clamp the work by operating the cam-lever handle which draws the two gates together so that the opposed pairs of guide pins are brought into contact with the work.

It might appear that the piece would be tipped in the jig when thus located, but this does not occur in actual practice. The arrangement makes for quick clamping action and provides a support for the thrust of the boring tool in such a location that it eliminates any tendency of the work to spring or distort under thrust of the cutter. It will be appreciated that this desirable feature is often difficult to obtain when locating a part of this type. One other noticeable feature of this jig is that it is of comparatively heavy construction for such a light piece of work, but it has been found that making jigs and fixtures stiff and heavy is good practice, as they will stand more rough usage by the workmen and so give satisfactory results for a longer period of time.

* * *

Production can often be materially increased if a more suitable grinding wheel for a particular class of work is substituted for the one being used. In this connection, the following experience of the Norton Co. is presented. One of their customers had been grinding pistons, 3½ inches in diameter and 5 inches long, with a grain 36, grade N, crystolon wheel. The production with this wheel averaged 10 pistons per hour and about 10 pistons per dressing of the wheel. By substituting a grain 36, grade L wheel, a production of 35 pistons per hour was obtained and the number of pistons ground per dressing of the wheel, increased to 32. The second wheel could be made to cut faster because it was softer, and being soft, the wheel wore slightly and constantly renewed its cutting face.



RECESSING AND CHAMFERING TOOL FOR HORIZONTAL BORING MACHINE

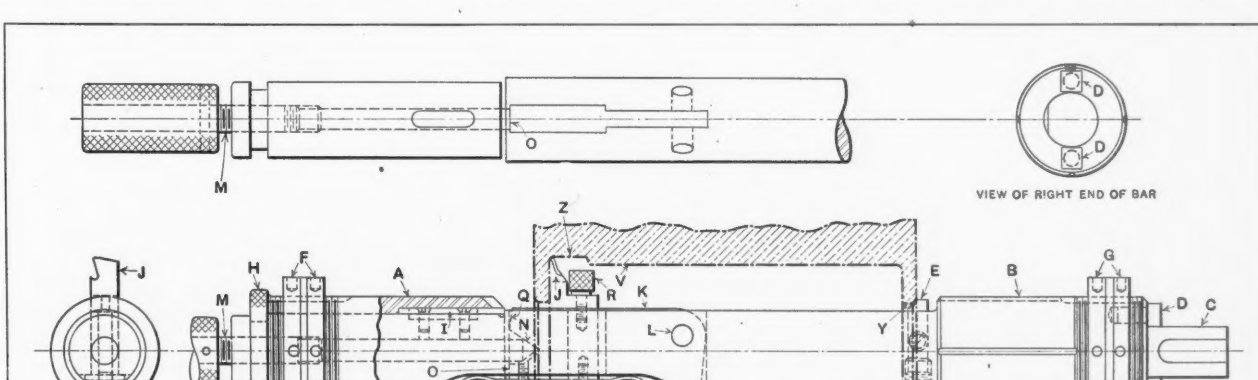
The boring-bar type of tool here illustrated has been designed for use on horizontal boring machines of the class in which the spindle revolves and the work is clamped on a stationary table. Several novel features are employed in its construction. On account of its length it is essential that the boring-bar be well supported, and this is accomplished by providing a suitably bushed bearing on each side of the work, in which the bar rotates while it is being used. The work is indicated in the illustration by heavy dot-and-dash lines. The operations performed by the boring-bar consist of chamfering the outer ends of holes *X* and *Y* and boring recess *Z*.

When the boring-bar is mounted in position for an operation, the surfaces which rest in the bearings previously mentioned are the circumferential surfaces of cutter *A* and part *B*, the latter being integral with the boring-bar proper. The boring-bar is connected to the driving spindle of the machine by means of a universal joint, the socket of which is slipped over end *C* and drives the boring-bar through two square keys *D*. Pin-cutter *E* chamfers hole *Y* when the boring-bar is fed toward the left. Cutter *A* is provided with teeth on the beveled end which chamfer hole *X* when the boring-bar is fed toward the right. In order to insure that neither hole *X* nor *Y* will be chamfered beyond the desired depth, stop-collars *F* and *G* are provided. These come in contact with the ends of the bearings that support the boring-bar and prevent further feeding of the bar. Cutter *A* is driven through key *I*, and is locked in place by the U-shaped collar *H*, which can be readily slipped off the boring-bar to permit the quick removal of the cutter from the bar and the withdrawal of the bar from the work after the completion of an operation.

Recess *Z* is machined by means of tool *J*, an ingenious arrangement being used for expanding this cutter after holes *X* and *Y* have been chamfered. It will be seen that this cutter is secured to a block *K* which swivels on pin *L*. In the front end of the block there is a wedge-shaped slot *N* in which the right end of screw *M* projects. This end of the screw is tapered to suit the slot, and so when the screw is rotated by turning the knurled handle on its left end, the opposite end of the screw advances into the slot and forces the block up or down, depending upon the direction in which the screw is rotated. If block *K* is forced up, the tool is fed into the work and, if it is lowered the reverse is true. The depth of the cut taken by tool *J* is regulated by block *K* coming in contact with surface *O* of the opening cut through the boring-bar to accommodate the block.

When the end of screw *M* is withdrawn from the slot, the withdrawal of the cutter from the recess to clear surface *V* on the work is assured by the flat spring *P*, which is attached to the block by means of two screws and which bears against the boring-bar at two points, thus causing the block to be pulled down until surface *Q* of the block comes in contact with surface *O* of the bar. The manner in which the cutter is ground will be apparent from reference to the left-end view of the bar. It is obvious that the boring-bar cannot be inserted through the hole of the work with cutter *J* in place; this cutter is attached to block *K* through an opening in the wall of the work, being secured to the block by means of the knurled-head screw *R*.

In operation, the boring-bar, with cutters *A* and *J* and collars *F* and *H* removed, and the tapered end of screw *M* withdrawn from the slot in block *K*, is passed through the hole at the right end of the work. Recess cutter *J* is then fastened to the swiveling block, as previously mentioned, after which the chamfering cutter *A* is put on the bar and secured in place by collar *H*. The cutters are now ready for operation, and after the boring-bar has been made to revolve, it is advanced through the work until hole *Y* has been chamfered,



Boring-bar with Two Cutters for chamfering Holes and a Third Cutter having an Expanding Arrangement for producing a Recess

the feeding movement of the boring-bar being obtained by means of a large pilot wheel that is used to operate the main spindle of the machine. The movement of the boring-bar is then reversed in order to chamfer hole X with cutter A. Next, while the boring-bar continues to revolve, the operator grasps the knurled handle on screw M, causing the tapered end of the screw to advance into the slot in block K and gradually feeding the cutter into the work. When the required depth has been reached, the feed of the machine is thrown in and the boring-bar advanced toward the left until the recess has been cut to the length required. The reason for employing a universal joint to drive the boring-bar is so that the latter will be held in correct alignment with the work during the operation, this being a common method of drive employed in performing work of this nature.

F. Server

BALL-GAGING MACHINE

The gaging of balls for high-grade ball bearings is at best difficult, due to the exactness of the operation and to the desired rapidity of the performance. Special machines have been designed for the purpose of sorting the balls so accurately that the variations in the diameters of the balls in an assortment will be less than the tolerance permitted on the balls entering the construction of one bearing. A machine based on the simple principle illustrated diagrammatically in Fig. 1 has been in use for a long time. It will be clearly seen that the balls are made to roll over an inclined plate having a tapered slot. When the ball reaches the point where the slot is wider than the diameter of the ball, it falls through the slot into a pocket in the machine. In this way the balls are sorted into a number of receptacles according to their size, even though the exact size of the balls in any one receptacle may be unknown. Each ball acquires momentum when rolling on the slide, and this prevents it from falling perpendicularly upon reaching the gaging point, so that, instead the ball follows the path indicated by the heavy dot-and-dash line in the illustration.

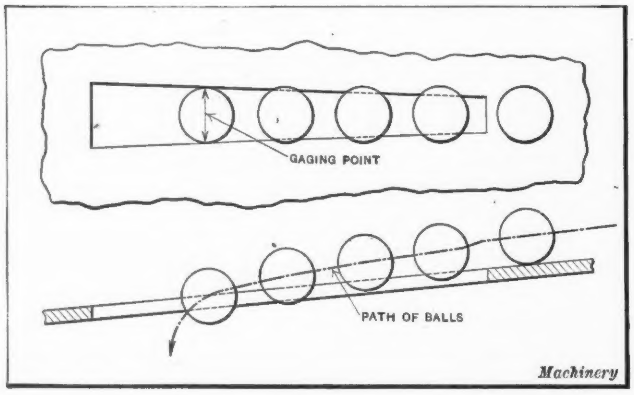


Fig. 1. Principle on which Balls are sorted in a Ball-gaging Machine

The machine illustrated in Fig. 2 has been designed by the writer to sort the balls according to a predetermined dimension, use being made of the well-known principle of the snap gage. Referring to the illustration, it will be seen that the driving shaft A, which rotates at the rate of 100 revolutions per minute, is driven by pulley B. The balls to be sorted are placed in hopper C and are agitated by the revolving part D which causes the balls to enter the enlarged opening of hole E, one at a time. Part D is mounted on shaft F, which is driven from the driving shaft through bevel gears G and H, the ratio of which is such that part D rotates at the rate of 150 revolutions per minute. The balls roll down passage E by gravity and drop, one at a time, into five holes in plate I, which is rotated by means of two sets of spur gears that connect shafts F and J. The ratio of this gearing is such that plate I revolves twenty times per minute, and as the plate rotates, the balls drop into slot K from the holes which they enter from passage E. The number of balls fed into slot K is 100 per minute.

The balls roll from slot K down an incline until they reach the position indicated by ball L, where they are stopped by weight M. At this point it will be noticed that there is an opening in the path of the balls, which is larger than their diameter. This opening is covered by two steel gaging plates N and O (see section X–X) having a space be-

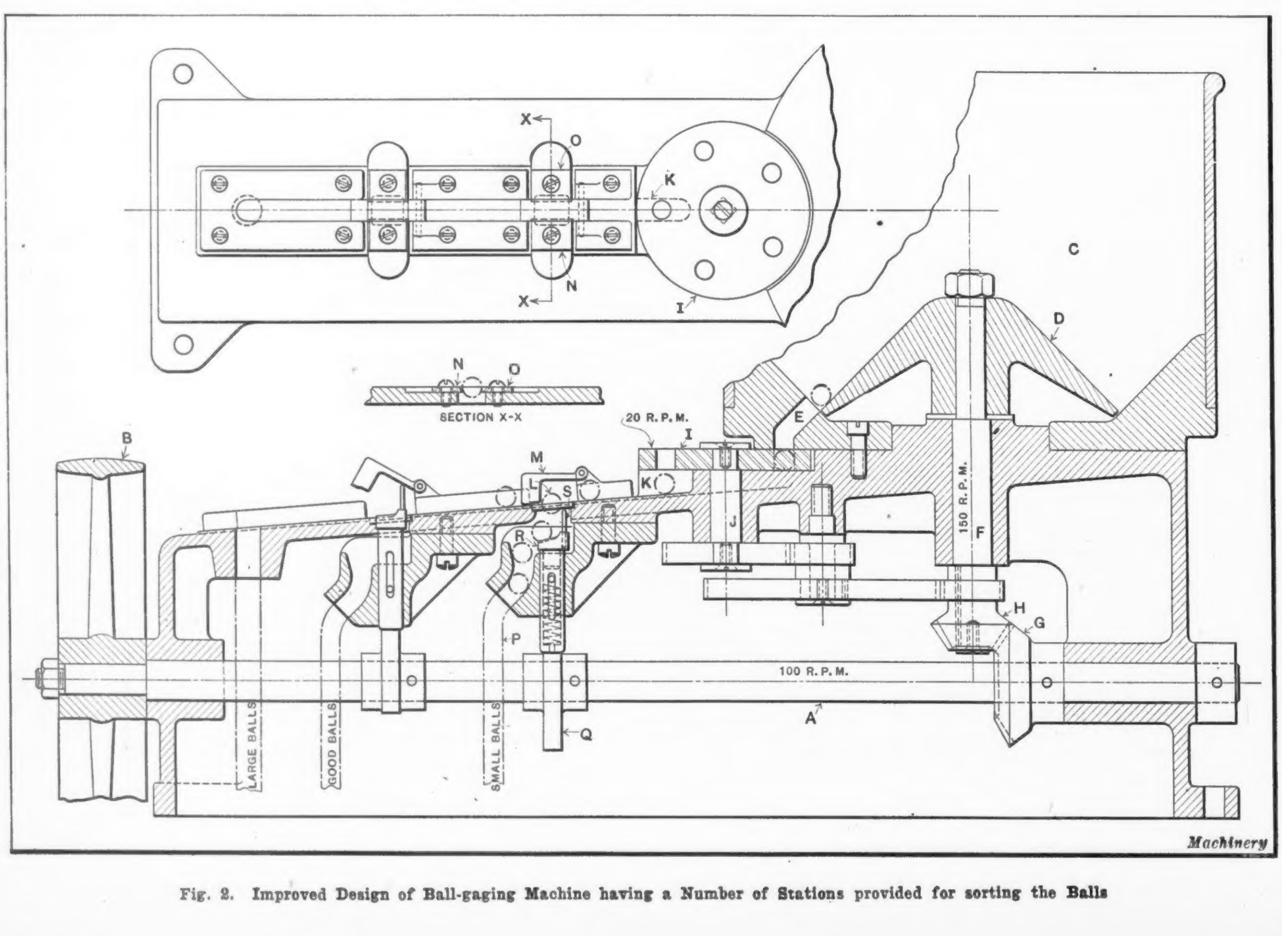


Fig. 2. Improved Design of Ball-gaging Machine having a Number of Stations provided for sorting the Balls

tween them of a width that will permit the ball to drop through the slot if it is smaller than the desired size. The gaging plates are properly spaced by means of a size block, the holes in the plates being larger than the screws by which they are attached to the machine housing, so that the plates can be set accurately by pressing them against the size block. When a ball drops through the gaging plates at this point, it is conducted to a container by means of the flexible pipe *P*.

If the ball is larger than the size limited by the opening, it cannot, of course, drop through, and so will hang on the plates until cam *Q* pushes plunger *R* upward, at which time the ball is lifted by the plunger so that it can roll down the incline to the next gaging station as weight *M* is swung upward by pin *S* on the plunger. The cam, plunger, and weight at the second station, are shown in the position they occupy when a ball is released from the station. Actually, however, the two cams on shaft *A* are so arranged that both plungers are raised and lowered together. If the ball falls through the gaging slot at the second station, it is within the required limits; however, if it does not drop through, it rolls down the incline to the end, where it is conveyed to a receptacle to be reground. This design can be developed to have an unlimited number of gaging stations, so as to sort balls of exceedingly slight variations in diameter.

New York City CHARLES RUIZ

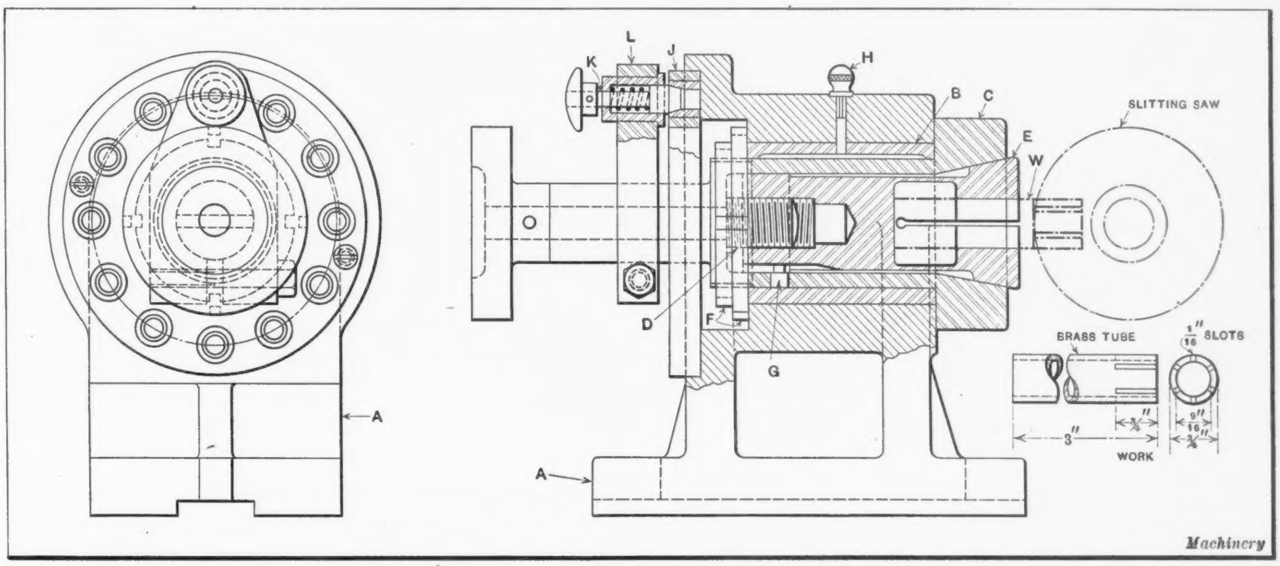
COLLET INDEX-HEAD

The construction of the collet index-head described in this article is clearly shown in the accompanying illustration, together with a piece of work which is representative of the type for which this collet index-head is especially adapted. The work is a piece of brass tubing, in the end of which six slots are cut 1/16 inch wide. The operation is performed on a Whitney hand milling machine, the base casting or body of the device being designed with a locating slot corresponding in width to the slots in the milling machine table. This collet head is suitable for use in cutting slots and keyways in a variety of light work.

The index-head itself consists of the previously mentioned body *A*, provided with a steel bushing *B* in which the collet sleeve *C* fits. It will be seen that this sleeve extends through and beyond the head at the rear, forming a bearing for the draw-bolt *D*. The split collet *E* is of standard construction, and is tapped in the end for the draw-bolt, as clearly shown, so that when the draw-bolt is screwed into the collet the latter will be drawn in and will securely chuck the work. A handwheel is pinned to the end of the draw-bolt, the construction being such as to permit the chucking of the work independently of the special indexing feature of this collet head. End play is taken up by two adjusting nuts *F*, and the collet is prevented from revolving by guide pin *G*, which fits into a slot in the collet.

Oiling facilities are provided by an oil-hole leading down through the body and the sleeve bushing *B*, to an oil-groove in the sleeve. A knob *H* is provided for this hole as a means of excluding dirt and other foreign substances. The indexing feature of the head consists of an index-plate *J* with a number of suitably laid out and bushed index-holes in which the spring detent or index-pin *K* may be engaged. The index-arm *L*, in which this spring-actuated pin is carried, is attached to the draw-bolt end of sleeve *C*, a construction which permits the chucking of the work and the subsequent indexing to be independently performed.

In operation, the cutter is set central with the index-head. The work is inserted in the collet and chucked in the regular manner by operating the draw-in handwheel. The table of the machine is then advanced until the slot has been cut to the proper depth, after which the work is withdrawn from the cutter and the spring pin *K* pulled out of its index-hole and revolved the required number of holes to give the proper spacing of the slots. The index-plate shown has twelve bushed holes, so the head is indexed every second hole.



Collet Index-head, and Type of Work for which it is especially suited

Collets can, of course, be designed to suit any type of work within the range of the head, and a number of index-plates may be used with the head, since these plates fit into and are attached by screws to the main casting. These two features extend the range of usefulness of this attachment so that a great variety of light work may be handled. This head has been used on such work as cutting 5/16-inch slots in steel and ⅜-inch slots in cast iron.

Pittsburg, Pa. WILLIAM OWEN

PITCH OF JIG CLAMPING SCREWS

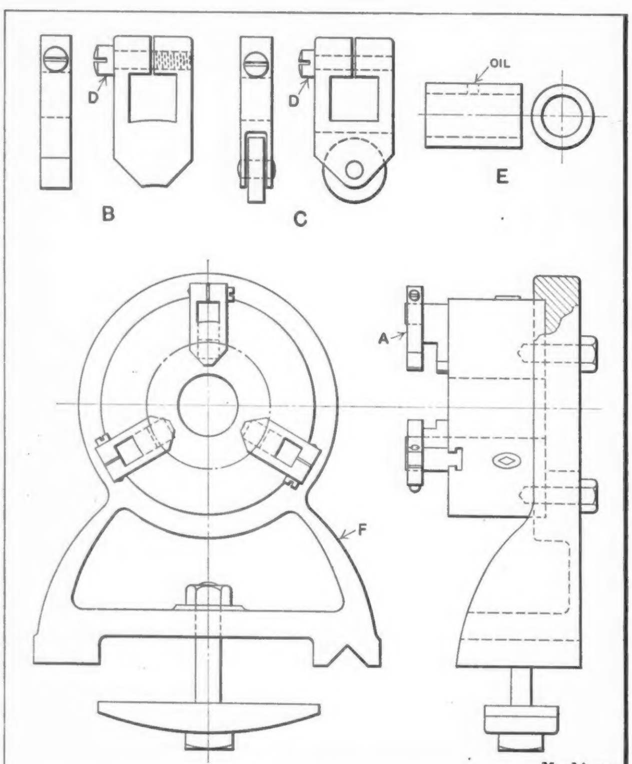
A tool designer is often obliged to use a thumb-screw for clamping work in a jig, when he would prefer to employ a cam-operated device but is prevented on account of the expense, or due to lack of space. In such cases the best results are secured by using a clamping screw having a coarse pitch. A screw ⅜ inch in diameter having sixteen threads per inch, may be powerful enough to hold the work, but the horizontal movement obtained in one revolution of a screw ¾ inch in diameter, having ten threads per inch, is 1.6 times that obtained by the former. Thus, it is obvious that a ¾-inch screw permits the work to be clamped and released more quickly than a ⅜-inch screw, and when the screw must be moved a considerable distance in clamping and releasing the work, much time can be saved by applying this principle.

Syracuse, N. Y. ELMER C. COOLEY

SELF-CENTERING LATHE STEADYREST

The accompanying illustration shows a self-centering steadyrest which will center work as accurately as will the regular universal chuck used in its construction, provided care is taken to obtain accurate alignment when machining and fitting the parts. The device consists of a cast-iron frame *F* similar to that of the ordinary steadyrest but without the hinged top or the slides and adjusting-screw brackets. Instead of using frame *F*, a standard could be made of a plain angle-plate, bored out for the chuck, and provided with bosses cast on the bottom which could be machined to fit the lathe ways. The frame or angle-plate, as the case may be, is bored out and recessed accurately in line and on a level with, the line of the lathe centers. A universal chuck is then fitted in the recess and bolted in place. The capacity of the steadyrest depends of course, upon the size of the hole in the chuck.

As the regular chuck jaws would spoil the finish on work revolved between them, special auxiliary jaws *A* are made and fitted over the regular jaws as shown. These can be either plain cast-iron jaws as shown in the enlarged view at *B* or they may be of steel and provided with hardened steel rollers as shown at *C*. The jaws are split and fitted with screws *D* for clamping over the outside chuck jaws. Sometimes it is better to use a plain bronze bushing *E* which is accurately reamed out to take the work. The bushing is, of course, held in the regular chuck jaws instead of in the auxiliary ones.

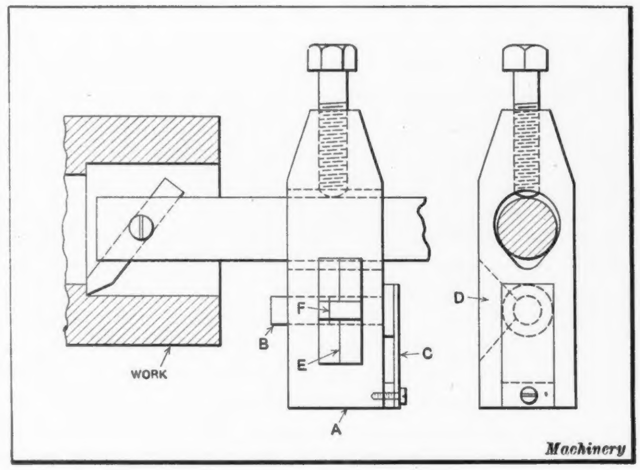


Self-centering Lathe Steadyrest

Oakland, Cal. H. H. PARKER

INDICATING STOP FOR BORING OPERATIONS

The illustration shows an indicator stop made by the writer to facilitate the boring of holes to shoulders which cannot be seen during the machining operation. The common methods of filing a mark on the boring-bar, or placing a chalk mark on the ways of the bed, to indicate when the cutter has been fed to the required depth, often prove unsatisfactory. However, with the stop illustrated, a depth gage is used to set the cutter for boring a hole, and the way the stop is employed insures accurate boring to depth.



Boring Stop having Scribed Lines that indicate when Hole has been machined to Proper Depth

It will be seen that the device consists essentially of stop *A*, pin *B*, and flat spring *C*. Stop *A* has a hole *D* milled in it to the depth of the hole provided for pin *B*. A line *E* is scribed on each of the slanting surfaces of this hole, and another fine line *F* is turned on pin *B*. In setting the cutter for boring to a certain depth, pin *B* is depressed until line *F* coincides with lines *E*, and the depth gage is used between the cutter and the edge of stop *A*. When pin *B* is released, spring *C* forces it back to the position shown. During the performance of the operation, the cutter is fed into the work until the lines of the stop and pin coincide, at which time the feed of the lathe carriage is disengaged by the operator. The latter should watch the stop from the time that pin *B* makes contact with the work, so that accurate boring will be obtained.

Rosemount, Montreal, Canada HARRY MOORE

ATTACHMENT FOR MILLING TURBINE-BLADE SPACERS

Production of the peculiarly shaped piece *A*, Fig. 1, which is a spacer used in large quantities to separate disk blades in the steam turbines manufactured by the Moore Steam Turbine Co., Wellsville, N. Y., was greatly increased by means of the milling machine attachment illustrated in Fig. 2. The part is made from special U-shaped rolled stock. The operation is performed on a Kempsmith milling machine, and consists of cutting the tongue on one end and severing the piece from the stock. Five milling cutters are required, three being mounted on the regular milling-cutter arbor of the machine, and the other two being placed on a special arbor provided on the attachment.

The operation is accomplished by clamping one end of the work in the vise of a fixture mounted on the machine table and then traversing the table past the cutters. Eighteen pieces of stock are clamped at one time in this fix-

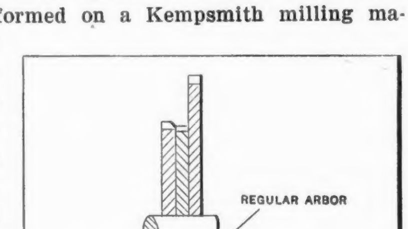


Fig. 1. Relative Positions of Milling Cutters

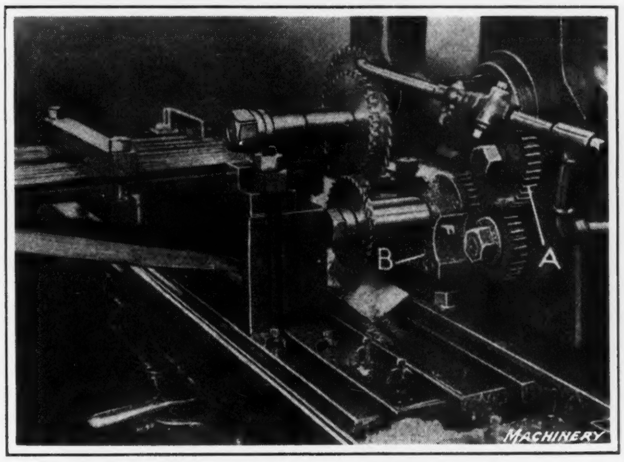


Fig. 2. Special Attachment used in milling Spacers for Steam Turbine Disk Blades

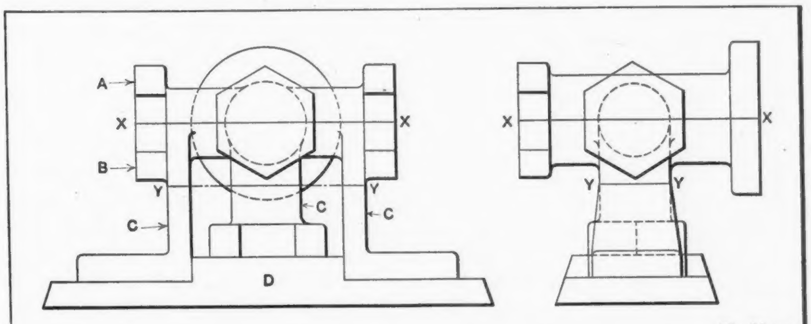
ture, care being taken to have them all parallel with the cutter-arbors, the U-shaped hollow of the stock being placed in a horizontal position as clearly seen in the illustrations. By this arrangement, eighteen spacers are formed and cut off at each traverse of the table. The opposite ends of the stock are supported on a horse and slide readily with the moving table, as the pieces of stock are clamped together at several points along their length. After a traverse of the table has been completed, the vise jaws are opened and the stock is pushed against a stop to locate the pieces properly for the next traverse, the vise jaws then being retightened.

The auxiliary milling-cutter arbor is mounted on a slide attached to the column of the machine, the arbor being driven by means of spur gears *A*, Fig. 2, which are also mounted on the slide and which are, in turn, driven by a gear on the regular arbor. The slide is not clamped in position on the column, but instead is located by a jack placed on the knee of the machine in back of the table. The projecting bearing *B* of the slide rests on the top of the jack elevating screw, permitting vertical adjustments of the slide and the milling cutters on the auxiliary arbor, which are secured by turning the nut on the jack. The production obtained through the use of the attachment described averaged 250 pieces per hour.

A. L. HIGHBERG

PATTERN FOR A FIVE-WAY VALVE

The designer of a five-way hydraulic valve to be used under high pressures was informed by a patternmaker that its design prevented it from being cast; subsequently, he took the drawing to another patternmaker who constructed the pattern as illustrated. It was decided to cast the valve solid and bore the different ports on a machine after the casting had been made. The pattern is made in three sections, *A*, *B*, *C*, being split along the lines *XX* and *YY*, at which places dowels and holes are provided for aligning the sections with each other. It will be noted from the illustration that the three portions of the pattern comprising section *C*, are attached to core-print *D* and thus held together.



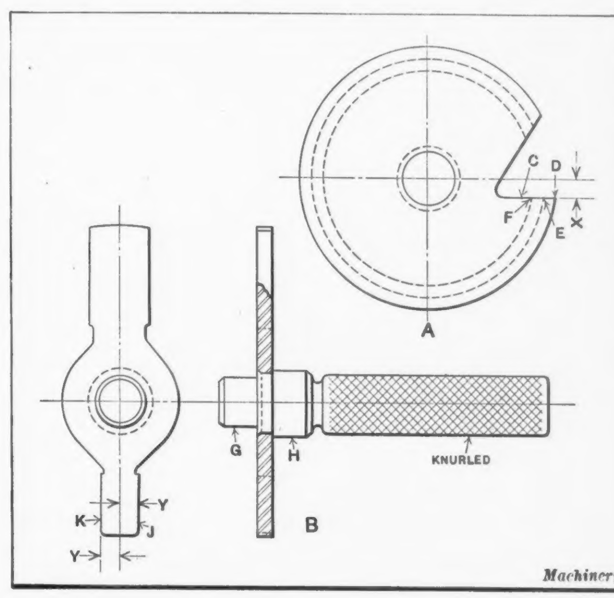
Design of Five-way Hydraulic Valve which permits Convenient Molding

In molding this pattern, sections *B* and *C* are placed together in the drag section of the flask with face *XX* of section *B* on the bottom board. After sand has been rammed around the sections up to the top of core-print *D*, the core-print and section *C* are lifted from the mold. A core corresponding to the core-print is then placed in the position formerly occupied by the core-print, and sand is rammed over the core to the top of the drag. Such a core is called a "ram-up" core on account of being rammed in the mold. The drag is then turned over so that face *XX* of section *B* is on top, after which section *A* is placed on section *B* and the cope is attached to the drag. After sand is rammed over section *A*, the cope is removed, section *A* extracted from it, and section *B* lifted from the drag. The cope is then replaced and the mold is complete except for closing the cope, making the gate, etc.

Kenosha, Wis. M. E. DUGGAN

GAGE USED IN GRINDING CIRCULAR FORMING TOOLS

In grinding the cutting edges of circular forming tools of the design shown at *A* in the accompanying illustration, great care must be taken to see that surface *C* is ground the proper distance below the center of the tool, and that it



Gage for Use in grinding the Cutting Edges of Circular Forming Tools

is ground so that when it is set for turning work, it will be in a plane exactly parallel with that of the horizontal center line of the automatic screw machine or lathe. If these points are not observed, the work will not be turned to the desired dimensions. For instance, if dimension *X* of the tool is slightly more or less than the distance that cutting edge *D* is set below the center line of the machine, obviously cutting edges *E* and *F* will not be in the same horizontal plane as cutting edge *D*. If dimension *X* is less than specified, cutting edge *D* will be higher than the others; and if the dimension is more, the reverse will be true. This, of course, has an effect on the diameters of the various surfaces of the work.

The gage shown at *B* was designed for ascertaining whether surface *C* has been ground properly, so that all cutting edges will lie in the same horizontal plane when cutting edge *D* is set in the correct relation to the center line of the machine. This gage may be used on two types of tools where dimension *X* differs, the lower end of the gage being used for testing the tool shown in

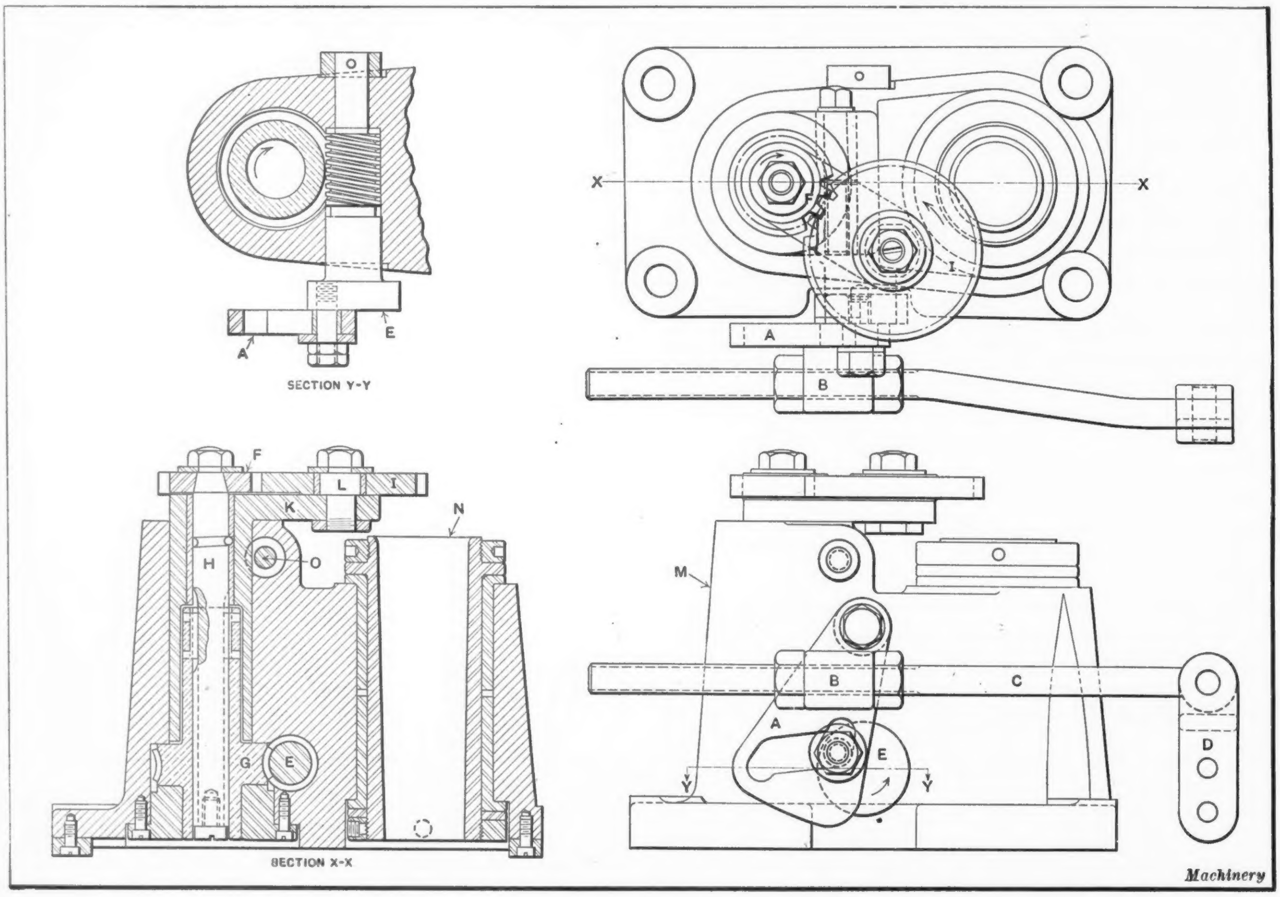
the illustration. Dimensions *Y* on the gage are the same as dimension *X* on the tool, and in using the gage, either plug *G* or *H* is inserted in the hole through the tool, and surface *J* or *K* of the gage is lined up with surface *C* of the tool. By holding the parts to the light, it can readily be observed whether these surfaces coincide. Plugs *G* and *H* are of different diameters to accommodate cutters having two sizes of holes. The gage could also be provided with a knurled handle to facilitate its use. B. SPECTOR

INDEX-HEAD FOR GEAR-TOOTH ROUNDING MACHINE

The geared index-head here illustrated was designed to replace a friction index-head on a spur-gear tooth-rounding machine, because trouble was experienced with the friction head due to slippage of certain parts, which resulted in improper indexing of the work and the production of poorly rounded teeth. With the new design, the indexing of the work, one tooth for every cut, is assured on account of the teeth of the work being in engagement with a gear in the indexing mechanism. The indexing movement occurs during the out and in strokes of the machine table after each cut has been completed and before another takes place; the manner in which it is obtained will be described in the following:

The index-head *M* is bolted to the machine table, and on the out stroke, the cam-plate *A* is swiveled about fulcrum *B*, which is held in a fixed relation to the machine base, irrespective of the movements of the table, by means of link *C* and bracket *D*. The cam-plate is returned to the position illustrated on the in stroke of the machine, and during its movement it has turned shaft *E* one revolution in the direction indicated by the arrow in the front view. By referring to section Y-Y, it will be seen that there is a worm integral with shaft *E*, and from section *X-X* it will be evident that this worm drives a worm-wheel *G* mounted on the vertical shaft *H*. The worm and worm-wheel are of such a pitch that one revolution of the worm causes gear *F*, which is mounted at the top of shaft *H* and is driven by it, to move a distance of one tooth. Gear *F* drives the intermediate gear *I*, which is in engagement with the teeth of the work. The gear on which teeth are being rounded is mounted on an arbor that is inserted in sleeve *N*. From this description, the operation of the indexing mechanism should be readily understood.

It will be seen that gears *F* and *I* are mounted on a sliding arm *K* which can be adjusted vertically to suit various heights at which work is placed in the head, being clamped in any position within the capacity of the head by means of the clamping screw *O*. Arm *K* can also be swiveled about shaft *H* so as to bring the teeth of gear *I* in engagement with work of various diameters. Gears of different pitches can also be accommodated, as stud *L* is eccentric to permit the center distance between gears *F* and *I* to be altered to suit. Perfect mesh of gears *F* and *I* and the work is obtained at the original setting for a class of work by loosening the nut on gear *F* and turning the gear without causing shaft *H* to be rotated, this being possible on account of the fact that gear *F* is not keyed to the shaft but is driven by being clamped on a tapered seat.



Index-head assuring Positive Indexing of the Work on Gear-tooth Rounding Machine

Port Huron, Mich. A. BASSOFF

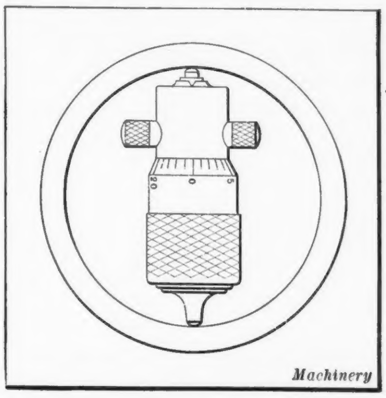
* * *

It is likely that the iron and steel industry in South Africa will gradually develop into an important factor in the world's industries. There are now six steel companies in operation, producing pig iron and open-hearth steel. The quantities produced are as yet comparatively small, but new equipment is being installed for further developments. The South African Government is endeavoring to aid the development of the iron and steel industry by assisting it in every possible way, and has entered into contracts with one of the steel companies to purchase 50 per cent of the South African federal railways' rail requirements for seventeen years. The annual requirements of South Africa in rails amounts to about 77,000 tons, and about 100,000 tons of other iron and steel products are used annually.

SHOP AND DRAFTING-ROOM KINKS

INCREASING THE RANGE OF AN INSIDE MICROMETER

In the accompanying illustration is shown a common inside micrometer, the range of which was considerably increased by substituting a piece of 5/32-inch drill rod in place of the shortest rod furnished with the micrometer. This simple change made the micrometer available for sizes as small as 1.610 inches. Such an increase would mean to many toolmakers, a doubling of the usefulness of this tool at a negligible outlay of time and material. While it is true that when thus equipped, the micrometer lacks both a positive stop and graduations for sizes less than 2 inches, it is also true that many toolmakers for a long time used inside measuring instruments that lacked both these features. The clamp screw holds the short rod firmly in place; and a 2-inch outside micrometer furnishes a ready means for taking readings or for setting the inside micrometer to sizes less than 2 inches.



Inside Micrometer provided with Short Rod to increase its Range

Wilkinsburg, Pa. WILLIAM S. ROWELL

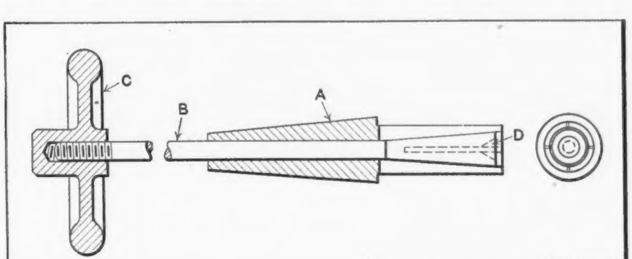
DETERMINING THE WEIGHT OF SMALL STAMPINGS

Recently, while compiling data pertaining to the weights of small stampings, the writer found that the use of MACHINERY'S Decimal Equivalent Sheet in connection with a scale for weighing parcel post packages, enabled the correct weight of each piece, expressed in decimal form, to be quickly obtained. The ratio of ounces to the pound being the same as sixteenths to the inch, the weight of an ounce, for instance, expressed decimally, would correspond to the sixteenth of an inch or 0.0625 pound.

Ypsilanti, Mich. FLOYD GRAVES

EXPANSION ARBOR

The accompanying illustration shows an expansion arbor that operates on the principle of a draw-in chuck. This arbor can be used in finishing work where the tailstock center cannot be employed, although the draw-in rod is provided with a center at *D*, which can be used when desired. The body of the arbor is tapered at *A* to fit the taper hole in the lathe headstock. The draw-in rod *B* serves to hold the arbor in place and also expands it in the work. Rod *B* extends through the machine spindle and is provided with a small handwheel *C* which bears against the spindle when the arbor is expanded. To loosen the arbor, the handwheel is turned back and the hub tapped lightly with a hammer. A number of arbors, to take work of different internal diameters, can be used with the same draw-in rod.

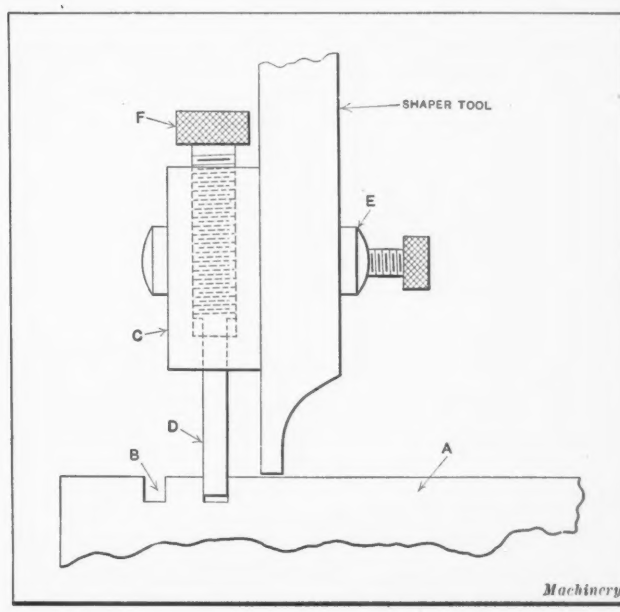


Expansion Arbor operated by Draw-in Rod

Oakland, Cal. H. H. PARKER

GROOVE-SPACING DEVICE FOR SHAPER

The groove-spacing or tool-setting device here illustrated was designed for use on a shaper tool when cutting a series of twelve equally spaced grooves. As a large number of pieces were required to be grooved in this way, the device saved considerable time by providing a simple means of obtaining accurate spacing between the grooves. The piece *C* was made from 5/8-inch square steel stock, being drilled and tapped to receive the threaded locating pin *D*. When in use, the device is clamped to the shaper tool by clamp *E*. The illustration shows quite clearly how the device is employed in setting the tool for each cut. After cutting a groove, pin *D* is advanced until it projects beyond the point of the shaper tool, by turning knurled head *F*. The table is then set over until pin *D* drops into a previously cut groove in the work *A*, as shown. The pin is next screwed back to clear the work, after which the groove is cut. This operation is repeated until the twelve grooves are completed.



Device for locating Shaper Tool when cutting Equally Spaced Grooves

Rosemount, Montreal, Canada HARRY MOORE

* * *

Commercial attaché Julian Arnold states that imports into China of different kinds of machinery are frequently credited to Canada when the machines arrive in Shanghai via Vancouver. Thus China has imports of textile machinery recorded in 1919 from Great Britain valued at $1,058,000; from the United States, $1,040,000; and from Canada, $1,482,000. It is quite evident that practically the entire exports of textile machinery from Canada to China were of American manufacture.

HOW AND WHY

QUESTIONS ON PRACTICAL SUBJECTS OF GENERAL INTEREST

PROBLEM IN TRIGONOMETRY

L. M. S.—Will you please show how to find angles A and B from the angle and dimensions given in the accompanying illustration?

ANSWERED BY MAX SILVER, NEWARK, N. J.

The following is a simpler solution of this problem than that appearing in the November number of MACHINERY, page 279. Referring to the illustration, first draw line XY, connecting the intersections of the dotted circular arc with lines

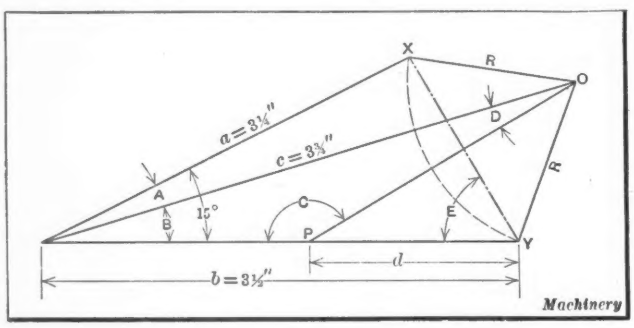


Diagram developed in Solution of Trigonometrical Problem

a and b. Then, from center O draw a line perpendicular to line XY, continuing until it meets line b at P. From trigonometry,

$$(XY)^2 = a^2 + b^2 - 2ab \cos 15 \text{ degrees}$$

Substituting the given values in this formula,

$$(XY)^2 = 10.5625 + 12.25 - 21.975 = 0.8378$$

$$XY = 0.9153 \text{ inches}$$

Then, according to the law of sines,

$$\frac{XY}{\sin 15 \text{ deg.}} = \frac{a}{\sin E} \qquad \text{Sin } E = \frac{a \sin 15 \text{ deg.}}{XY}$$

Substituting values,

$$\text{Sin } E = \frac{3.25 \times 0.25882}{0.9153} = 0.919$$

Therefore,

$$E = 66 \text{ degrees } 47 \text{ minutes}$$

The triangle OXY is an isosceles triangle, and for this reason line OP bisects line XY. It is now possible to determine the length of line d by the formula

$$d = \frac{XY \sec E}{2}$$

Substituting the known values and solving,

$$d = 1.1609 \text{ inches}$$

and

$$b - d = 3.5 - 1.1609 = 2.3391 \text{ inches}$$

It is evident that

$$C = E + 90 \text{ degrees}$$

Thus

$$C = 66 \text{ deg. } 47 \text{ min.} + 90 \text{ deg.} = 156 \text{ deg. } 47 \text{ min.}$$

Again, according to the law of sines

$$\frac{b-d}{\sin D} = \frac{c}{\sin C} \qquad \text{Sin } D = \frac{(b-d) \sin C}{c}$$

Inserting the proper values,

$$\text{Sin } D = \frac{2.3391 \times 0.39421}{3.75} = 0.24589$$

and

$$D = 14 \text{ degrees } 14 \text{ minutes.}$$

$$B = 180 \text{ deg.} - (C + D) = 180 \text{ deg.} - (156 \text{ deg. } 47 \text{ min.} + 14 \text{ deg. } 14 \text{ min.}) = 8 \text{ deg. } 59 \text{ min.}$$

and

$$A = 15 \text{ deg.} - B$$
$$= 15 \text{ deg.} - 8 \text{ deg. } 59 \text{ min.} = 6 \text{ deg. } 1 \text{ min.}$$

MATHEMATICAL PROBLEM

D. D. H.—Can someone show how to find dimension x in the illustration, the lengths of sides a, b, and c being given and angles AEB and CED being equal?

A.—First, designate both angles AEB and CED as angle N. It is obvious that $N = X - Y$. Then,

$$\text{Tan } N = \tan (X - Y) = \frac{c}{x}$$

$$\text{Tan } X = \frac{s}{x}, \text{ and } \tan Y = \frac{b + c}{x}$$

From trigonometry the following relation is obtained:

$$\text{Tan } (X - Y) = \frac{\tan X - \tan Y}{1 + \tan X \tan Y}$$

Substituting the values previously found,

$$\frac{c}{x} = \frac{\dfrac{s - b - c}{x}}{1 + \dfrac{s(b + c)}{x^2}} = \frac{x(s - b - c)}{x^2 + s(b + c)}$$

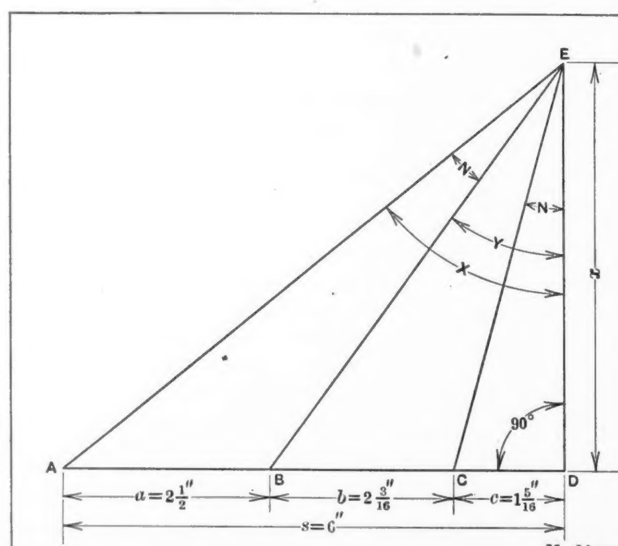


Illustration showing Conditions of Mathematical Problem

Clearing of fractions and combining terms,

$$x^2 (s - 2c - b) = cs (b + c)$$

$$x = \sqrt{\frac{cs (b + c)}{s - 2c - b}}$$

Reducing the dimensions of sides a, b, c, and s to sixteenths of an inch and inserting these numerical values,

$$x = \sqrt{\frac{21^2}{19}}$$

Therefore,

$$x = \frac{21\sqrt{19}}{19} = 4.8177 \text{ inches}$$

W. W. J.

The British Machine Tool Industry

From MACHINERY'S Special Correspondent

London, February 11

THE position of the general engineering trades is reflected in the machine tool industry and may be summed up as being very quiet. Few tools are being sold, and short working hours are general. Railway, electrical, and marine shops are the most active, and there is still plenty of work for shipbuilders; in fact, but for the shipyard joiners' strike, this particular industry would not be much disturbed. Although inactivity has developed to an astonishing degree, optimism is not wanting, and the position will yield to the improved conditions that will slowly but surely develop. With markets for raw materials falling, quotations for finished products will follow suit.

As far as the machine tool trade is concerned, there may be some reductions, but only in so far as lower raw material values justify. Wages are not reduced, and in machine tool building wages represent a large proportion of the manufacturing cost. Many firms are putting through batches of their most popular lines to stock, and are taking the risk against any attempt at a forced realization; but while stocks may have accumulated and the financial position proves rather difficult to handle, most of the makers have a reserve which will tide them over and render unnecessary the realization of stock at reduced prices for the sake of getting the money necessary to continue work. Many of the inquiries are from locomotive and car builders, pipe manufacturers, and railway shops and dockyards abroad. In South America the railways have large schemes of reconstruction afoot, and there should be good business for someone there before long. Shipbuilding in Spain also accounts for a few inquiries. The Indian market, which flared up for a time, is for the moment flat.

German Tools and Competition

The representatives of German machine tool makers are reported to have been active in the Lancashire districts. They are seeking to appoint sole agents who will carry their products, one firm alone having been approached by four separate concerns. Machine tools from these sources are arriving and are being readily disposed of because on the question of price a considerable advantage is held.

In view of the important decision made by the Machine Tool Trades Association at its annual general meeting last week, the question of German agencies will soon settle itself. At that meeting Sir Alfred Herbert moved from the chair the resolution that none of the members should handle German machine tools. In proposing this resolution Sir Alfred stated that his own company was an importing as well as a manufacturing company, and stood to lose, in common with other importers, anything that was to be lost, in sacrificing the right to import machine tools while remaining members of the association. He was quite aware of the nature of the argument against the resolution. The argument was that German machine tools would be brought in anyway by somebody, and why should the members of the association be deprived of the profit, if there be any, attached to the importation of German machine tools? There were many trades to which profits attached, in which trades they preferred not to embark, but he felt that it would satisfy the findings of the association to uphold the high standard which it aimed at, if its members were prepared to make such sacrifices as might be attached to the refusal to deal in German goods. If the resolution was carried, there would be a very serious blow at the importation of German goods in the future.

On the other hand, if the resolution was not carried, they could all begin, if they chose, to import German goods, and they would begin to sell them or try to sell them. There was no need to remind them that as long as the German exchange remained at its present level, it was impossible to compete with German machine tools. It was no use trying, because it was not a question of 10 or 15 per cent, which they might sacrifice out of their margins, but 50 or 70 per cent, which they could not compete with. Under these circumstances, if the resolution was carried, they would all begin to deal in German machine tools.

An amendment offered by some member to include American machine tools in the resolution was not favored by Sir Alfred, and it did not find many supporters. The amendment, finding no seconder, was withdrawn; and as a result of a full and interesting discussion, Sir Alfred's original resolution was not carried. The feeling of the meeting was that adoption of the resolution would not prevent the commercial handling in this country of German tools, and that as manufacturers the British machine tool builders did not fear their ability to hold their own. Another aspect is that a considerable agency trade is done through British firms with countries abroad who do not object to German tools.

The Autumn exhibition held by the Machine Tool Trades Association at Olympia produced a satisfactory financial result, whereby the funds of the association were improved by the substantial sum of over £8000. It was decided to hold the next exhibition in 1924.

Machine Tool Imports and Exports

The final month of the year continued the favorable tendencies which prevailed for the three previous months. As exports increase, their average value per ton falls; imports rise in average value per ton as the weight falls. The imports are still much too heavy to indicate a healthy state of exchange. The returns for the complete year show that the most striking difference is the enormous rise in the tonnage and value of imports, with no defined tendency to return to pre-war levels. The exports have increased in tonnage by nearly 50 per cent over the pre-war level; and this is the more satisfactory owing to the steady level from 1913 to 1919, which was not greatly disturbed by the war.

Iron and Steel Trade

In the iron and steel trade, recent quotations show substantial reductions in price. Notwithstanding these, buyers are not committing themselves except to purchases of materials urgently required. They are content to wait for further cuts, which they regard as inevitable. Meanwhile foreign competition is becoming more intense, particularly on the part of Belgium, which country is securing orders much needed at home. There are still considerable stocks of finished iron and steel goods in most of the distributive channels, and it is reported that big engineering concerns are to put in the market some large stocks of raw material bought against orders which have been cancelled or otherwise suspended. Scottish steel manufacturers have reduced the price of steel by £5 a ton during the last two months, but Sheffield manufacturers say they could not produce billets at the Belgian price of £11 to £12 per ton and at

the same time pay the current rate of wages, even if all profits were sacrificed.

Employment and Piece-work

The official returns of employment in the engineering trades last month showed a decline as compared with the previous month. With some classes of men in certain districts it was fairly good, but in most of the principal districts it was slack. A large number of men were out of work, and there was much short time. With iron-founders, employment was good at most centers, but not so good as in previous months. One of the most satisfactory features of the crisis is that with the consent of the operatives a great many factories, instead of indulging in wholesale discharges, are running on the short-time alternative.

The piece-work system, which applies very generally in the Birmingham area, is being largely extended in the foundries, where it was formerly resisted by the unions. It is credited with having been very influential in promoting a marked increase of output. The patternmakers are now the only body of workmen who stand outside the payment by results principle.

Women in Engineering Industry

The advent of women in the engineering trade is an accomplished fact. A small limited company has been formed by women under the title of Atalanta, Ltd., which has powers to manufacture automobiles, bicycles, and the like, but with the special purpose of manufacturing engineering components. Shops have been secured at Loughborough, but the women, it is noticed, are not quite self-reliant, since they have secured the services of Mr. Schofield of the Loughborough Technical College, who during the war devoted himself to the training of women.

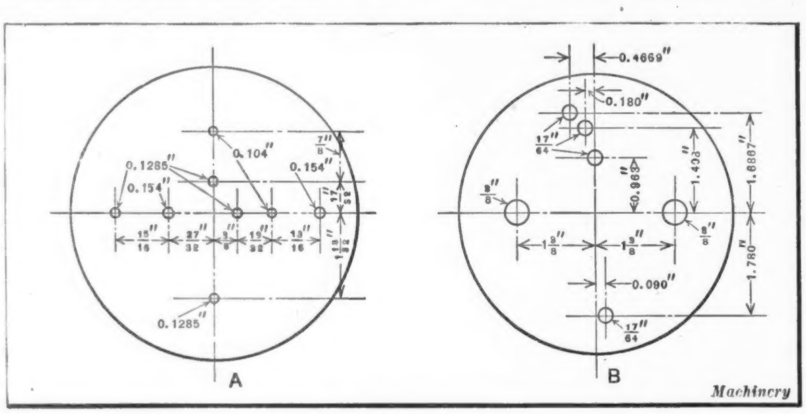


Fig. 1. (A) Part drilled on Machine shown in Fig. 2. (B) Part drilled on Machine shown in Fig. 3

New British Machine Tools

As an addition to its range of turret lathes having a center height of 8 inches, Alfred Herbert, Ltd., Coventry, is now building the No. 3 combination turret lathe, uniform in many dimensions with the No. 9 machine. The new model, however, will handle work of greater length, between the spindle flange and the turret face, namely, 51 inches. This new machine was originally designed just prior to the outbreak of the war, but its manufacture was not proceeded with until recently. As an outcome of specialized experience, the lathe embodies several features of interest, in particular the provision of power movements wherever possible. Oldfield & Schofield Co., Ltd., Halifax, has recently developed a crank-shaping machine, which is being built on an interchangeable basis, in 12-, 16-, 20-, 24- and 30-inch stroke sizes. They are supplied in either cone-driven or gear-box types. Through this gear-box eight speed changes are obtainable by means of sliding gears. The shafts run in ball bearings. In order to eliminate knocking through wear at each end of the ram stroke, the crank-arm, which is a steel casting, is fitted with a hardened steel bushing in the first hole and rocks on a hardened steel stud.

* * *

The United States Steel Corporation reports that from January 1, 1912, to September 30, 1920, it expended over $81,000,000 for safety, sanitation and welfare among its employes.

MACHINES FOR MULTIPLE DRILLING OPERATIONS ON SMALL PARTS

The manufacture of small interchangeable parts such as shown in Figs. 1 and 5 presents a problem of interest to production engineers and designers. While it may not be a difficult matter to make a few parts like the one shown at *A*, Fig. 1, by employing tool-room methods, it becomes an entirely different problem when it is required to produce parts of this kind on a production basis and at the same time maintain the required accuracy. From the illustration it will be evident that considerable time must be consumed in drilling the various holes required in the piece if an ordinary single-spindle drilling machine is employed, even though an accurate drill jig is provided. For instance, it will be necessary to place an 0.1285-inch drill in the drilling machine spindle and drill the three holes which require this size drill. Then this drill is removed and replaced with an 0.154-inch drill. After drilling the two holes of this size, the drill is removed and a 0.104-inch drill substituted, with which the two remaining holes are drilled.

To perform the drilling operation in this way results in the loss of considerable time that could be saved by the use of a multiple-spindle drilling machine with which the work can be done in one operation. A machine adapted for this particular operation, which was made by the Langelier Mfg. Co., Providence, R. I., is shown in Fig. 2. The close grouping of the spindles of the multiple-spindle drilling head of this machine is a feature of particular interest. Referring to the illustration, it will be noted that tight and loose pulleys are mounted on the base of the machine. The drive is from an overhead belt, which can be shifted from the tight to the loose pulley, or vice versa, by a conveniently located foot-pedal.

It will also be noticed that a kettle-shaped coolant tank is attached to the lower oil or coolant tray which is cast integral with the machine base. A pump for circulating the coolant is located at the bottom of the coolant tank. This pump is driven from the main drive shaft on which the tight and loose pulleys are located, by means of a belt. When the machine is in operation, the coolant is pumped through piping to a nozzle which delivers it to the drills. From the work the coolant drips back into the coolant tank tray and thence through a strainer into the tank. The drilling head is advanced to the work by means of a rack and pinion operated by the usual type of hand-feed lever. The weight of the drilling head is balanced by two extension springs.

The special-purpose Langelier drilling machine shown in Fig. 3 was built for the purpose of drilling the part shown at *B*, Fig. 1. Referring to this illustration, it will be noted that two 3/8-inch holes and four 17/64-inch holes are required to be drilled. It will also be noted that these holes must be accurately located in relation to each other. In producing this particular piece of work, it was found desirable to drill the two 3/8-inch holes separately, and for this purpose the machine was equipped with the single spindle shown at the right. For the four 17/64-inch holes, however, a multiple-spindle drilling head was provided. By locating the single-spindle and the multiple-spindle drilling head on the same base as shown, it is possible to transfer the work quickly from one drilling position to the other.

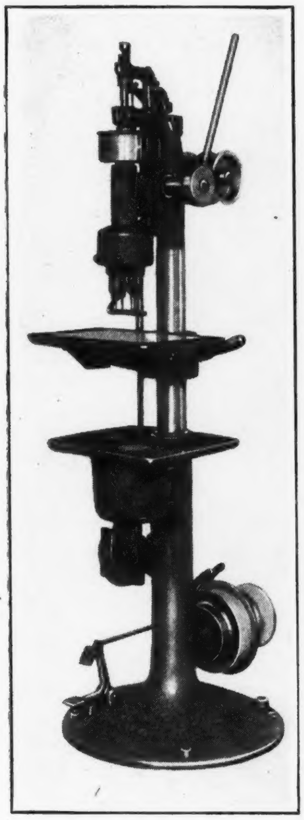


Fig. 2. Machine for drilling Part shown at A, Fig. 1

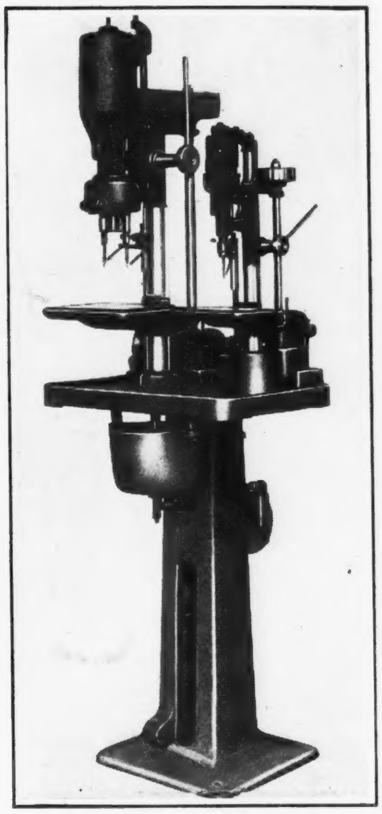


Fig. 3. Machine for drilling Piece shown at B, Fig. 1

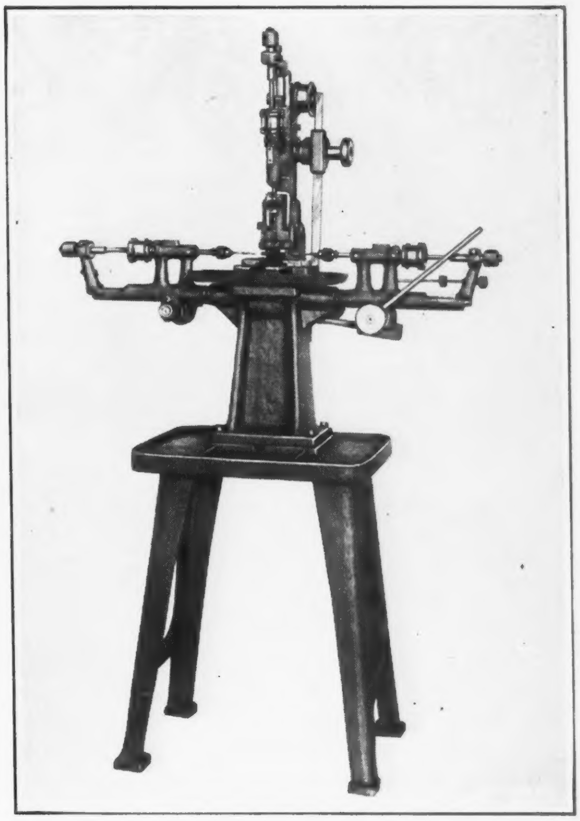


Fig. 4. Three-spindle Machine designed for drilling Battery Cap illustrated in Fig. 5

The Langelier machine shown in Fig. 4, was designed for drilling a storage battery cover (Fig. 5). The two ⅛-inch horizontal holes and the ⅛-inch angular hole are drilled simultaneously by a movement of one feeding lever, which rotates a shaft on which two pinions are mounted. One of the pinions meshes with a rack which actuates the horizontal spindle shown at the right. The other pinion operates a rack which, in turn, transmits motion to the horizontal spindle shown at the left, through another rack and pinion. A similar rack and pinion is also used to transmit motion to the angular spindle. It will be noted that each of the spindles is provided with a pulley so that a separate belt drive is employed for each. The vertical or angular spindle runs at a speed of 2900 revolutions per minute, and the horizontal spindles operate at a speed of 3200 revolutions per minute. The rate of output of this machine is five pieces per minute.

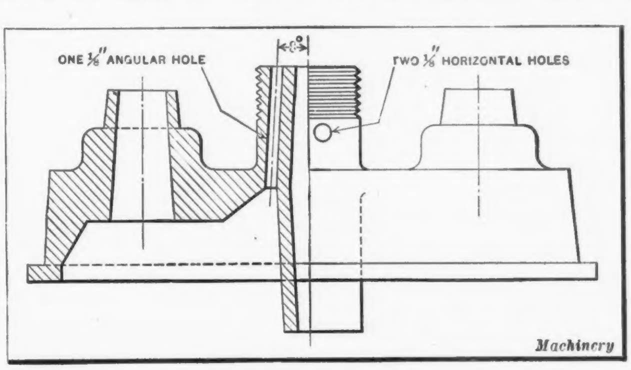


Fig. 5. Part drilled on Machine shown in Fig. 4

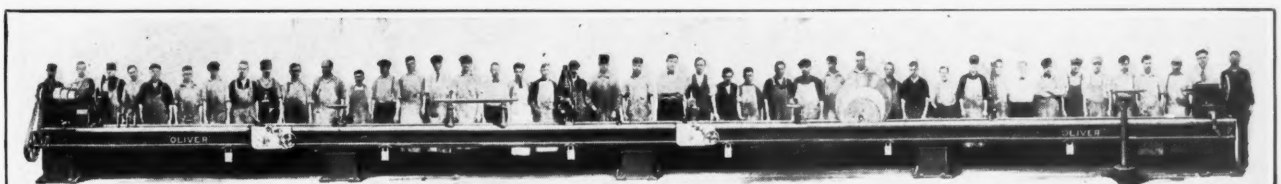
* * *

SPECIAL WOOD-TURNING LATHE

The special wood-turning lathe shown in the accompanying illustration was designed and built by the Oliver Machinery Co., Grand Rapids, Mich., in accordance with specifications written for the United States Government. This machine is known as the Oliver No. 18-A special wood-turning lathe. It will swing work 32 inches in diameter, and has a bed 62 feet in length. Reference to the illustration will show that the lathe is equipped with two carriages and two steadyrests. The carriages are provided with power feed, and the steadyrests furnish support for long heavy work such as spars or ship masts. The forty-four men lined up at the back of the machine give an idea of the exceptional length of this machine. It may be mentioned that each man in the group, from the designer to the shipping clerk, had some part in the production of the machine.

* * *

Important work is planned on the railway systems of Japan for the next few years. A large appropriation has been made by the government for the electrification of some of the important railway lines of the country, and it is believed that still larger appropriations will be made in the near future for general development of the whole railway system. It is expected that in connection with this work a great deal of material and rolling stock will be imported into Japan.



Oliver Special Wood-turning Lathe built for the United States Government for turning Ship Masts

Prices and Wages in the Machine Tool Industry

An Interview with a Machine Tool Manufacturer

OF all the problems facing machine tool builders, none is more important than that relating to the prices of machine tools and the wages paid in the machine tool industry relative to the wages paid to other classes of labor. At this time, when there have been decided reductions in the prices of the products of the textile, leather, and other industries, as well as of many of the raw materials used in those industries, buyers generally expect similar reductions in every field, and are looking forward to reduced prices for machine tools and accessories.

It is therefore of importance that a careful analysis be made of the conditions existing in the different industries with a view to determining whether the reductions in prices made in some directions justify reductions elsewhere. It is quite clear to any observer who wishes to examine the facts that the conditions in the textile industry, for example, are entirely different from those in the machine industry.

The Question of Materials

First let us deal briefly with the question of raw materials. In the textile industry the raw materials used have been reduced in price in some instances about one-half, in some cases even a greater amount. In the shoe and leather industry a similar condition obtains. In the machine-building industries there have been no such reductions. The price of steel quoted by the U. S. Steel Corporation is today the same as two years ago, and that price is about twice the price of six years ago. In the case of cast iron, the reductions on castings amount to no more than 10 per cent, at best, while in many localities there has, as yet, been no reduction at all. True, there has been a reduction in pig iron from the high peak price, amounting to from 20 to 30 per cent. On the average machine tool this reduction would justify a decrease in price of not more than 2 or 3 per cent, because the cost of the raw material in the form of pig iron, compared with labor and other costs in the manufacture of machine tools, is quite insignificant. As a result, the textile industries are in a position to show a decided reduction in the price of their finished product because of the reduction in the raw materials that they use. The machine tool industry is practically unaffected by any reductions that have as yet been made in the materials this industry uses.

The Question of Wages

The real question to be analyzed, however, is that of wages. In the machine tool industries, wages and prices have risen since 1915 in practically the same ratio, both having just about doubled. In the textile and leather industries prices have trebled and quadrupled, and wages have risen on an average 150 per cent. In one specific New England mill center, wages rose 173 per cent from January 1, 1916, to the highest peak in 1920. In another large textile center the rise was 169 per cent. Hence, mill workers who in the past were paid less than machinists, have been paid at a higher rate, and the machinists and toolmakers, whose skill and knowledge should entitle them to a higher reward than that received by the comparatively unskilled labor of the textile mills, are not receiving the compensation that will attract to the industry the best classes of workers, simply because the industry has been unable to obtain prices comparable to those obtained in the textile industries.

We have now come to a turning point where the textile mills are forced to reduce wages; but in the machine industries wages cannot be reduced in the same proportion except in some localities where they were unduly advanced by the pressure of the emergency that we have passed through, and where a decided adjustment is necessary. Where the advances were reasonable, however, a higher standard would be created in the machine-building industry if wages could be practically maintained. Many manufacturers believe that this would be the best policy for the welfare of the machine tool industry of the country, and that for that reason prices should not be reduced at the present time, because they have never been unduly increased.

Of course, there have been several reductions in machine tool prices recently, and wage adjustments no doubt will have to be made to meet the new conditions. But drastic price reductions are not warranted, and by avoiding them, it will be possible to maintain wages at a level commensurate with the skill and ability of the worker in the machine tool industry. Textile workers, for example, need not always have the ability to read or write. Their education can be much inferior to that of the workers in the machine-building industries. The machinist or toolmaker, on the other hand, needs an education and mental equipment superior to that of most of the average workers in other industries and trades, and if possible his wages should be such as to attract and hold a high grade of men.

Basis for Determining Reasonable Wages

The best method whereby a reasonable wage in the machine tool industry might be determined would be to compare the wage schedules in force in machine shops on January 1, 1915, with the schedule in force on January 1, 1921, and to base the present rate on a definite ratio between the wages of six years ago and today, making as a basis for the present wage schedules the present cost of living and the wages paid in other occupations that require the same skill that the machinist must have.

In most instances it will be found that if the machine tool industry is to be enabled to pay wages based upon a comparison such as mentioned, present prices cannot be reduced. The buyers of machine tools must be impressed with the fact that machine tools did not increase in price in the same ratio as numerous other manufactured products; and for that reason they cannot be reduced simply because other industries are enabled to undertake reductions. Drastic wage reductions may be warranted and feasible in the textile industry because the increases have been extraordinary, but such great reductions in wages are not advisable in the machine tool industry, because it is in the interest of the industry as a whole to maintain a high standard of workers. Manufacturers in general are reluctant to make the work in the industry less attractive than in other occupations because of unfavorable wage conditions. They wish to maintain a fair rate of wages to keep the right kind of workers for the development of the industry. The development and improvement in machine tools, in turn, means a great deal to the users of machine tools, who are thereby enabled to purchase more highly productive machines, increase their output, and reduce their costs.

NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW AMERICAN METAL-WORKING MACHINERY

Hartness Automatic Lathe

The Hartness automatic lathe is adapted for the simultaneous performance of boring, turning, and facing operations, and is therefore especially suitable for the efficient machining of simple castings and forgings of the class of which ring gears are typical. Sufficient capacity is furnished for handling work up to 12 inches in diameter by 6 inches in length. The cutting tools are mounted on their heads in such a way that when a series of cuts is being taken, the strains are distributed and the tools operate under conditions that will insure freedom from vibration.

A MACHINE for simultaneously performing boring, turning, and facing operations on work up to 12 inches in diameter by 6 inches in length, which is intended especially for the machining of simple forgings and castings such as ring gears, has been recently introduced to the trade by the Jones & Lamson Machine Co., Springfield, Vt. Although this machine is not suitable for drilling and tapping, it is adapted for the finish-boring of rough and cored holes. The cutting tools employed on the machine are short and stubby, and they are mounted on the heads in such a way that when a series of cuts is being taken, the tools are grouped in and around the work.

Two tool-heads are provided on the machine, as shown at *A* and *B* in Figs. 1 and 2, these tool-heads being of the cat-head type and supported on the ends of large hollow bars carried by bearings in the main frame which contains the work-holding spindle on which chuck *C* is mounted. The construction of the main frame is such that the tool-heads are supported beyond the chuck face and practically in line with the cutting thrusts, thus giving a rigid control of the tools in relation to the work-spindle. The tool-heads are swiveled slightly in order to bring the different tools in contact with the work and they are fed longitudinally in relation to the work-spindle for the performance of boring and turning operations.

Tool-head *A* is primarily intended for precision boring and turning operations, while tool-head *B* is especially suited for facing operations. The oscillating and longitudinal movements of the tool-heads are governed by cam-drum *D* which is supported at the top of the main frame. The drum has four separate cams, two on its cylindrical surface and one face-cam on each end. The cylindrical cams control the longitudinal movements of the tool-heads, while the face-cams govern the oscillating or cross-feed movements. The two cams at the front end of the drum control tool-head *A*, while those at the opposite end control tool-head

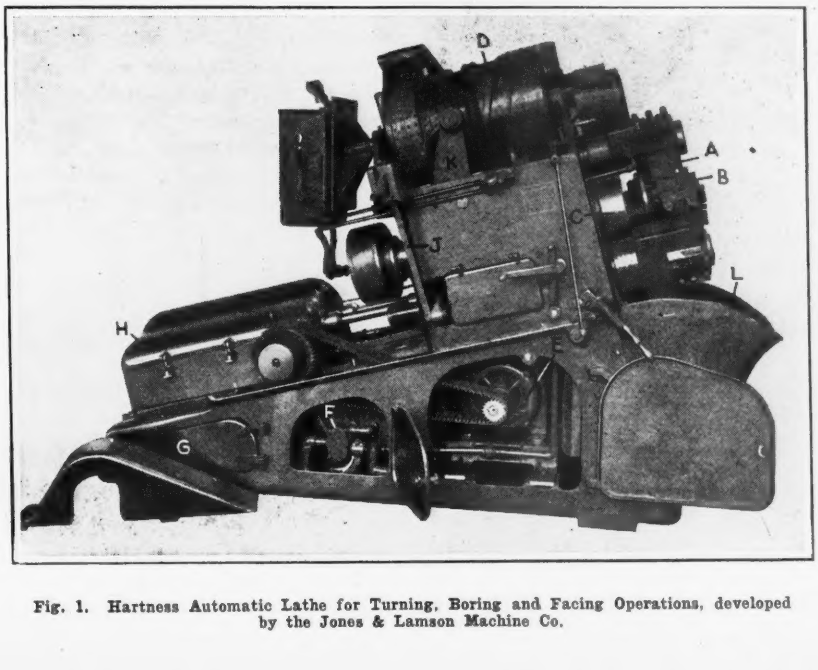


Fig. 1. Hartness Automatic Lathe for Turning, Boring and Facing Operations, developed by the Jones & Lamson Machine Co.

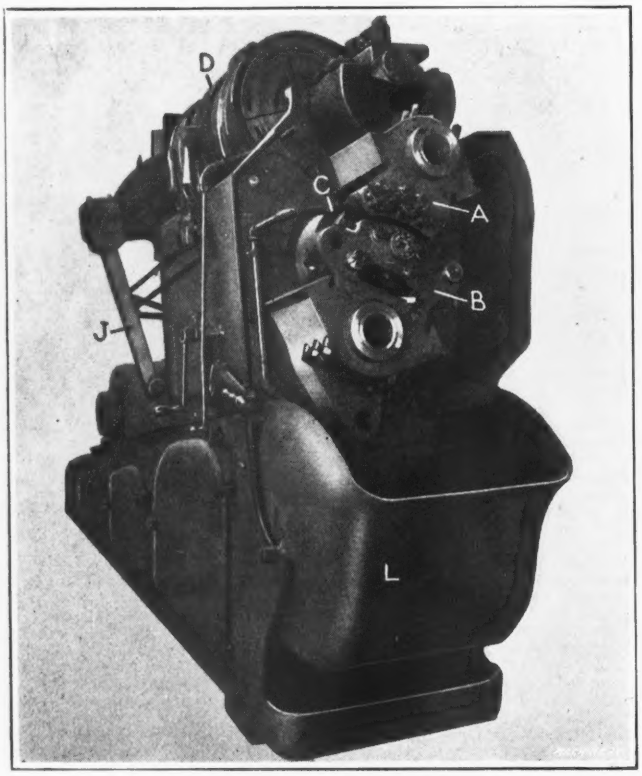


Fig. 2. End View of Automatic Lathe showing Arrangement of Both Tool-heads

B. The arm shown at *J* transmits the movement imparted by the rear face-cam to the bar on which tool-head *B* is mounted, while the arm *K*, Fig. 1, imparts the lengthwise movement of the cylindrical cam to this tool-head.

The main frame of the machine is mounted on a base, the upper surface of which is inclined. When the machine is motor-driven, the motor is located in this base, as shown at *E*, and it is connected with the gearing in the transmission case by means of a silent chain or belt drive. The pump is also placed in the base at *F* and driven from the main drive of the machine. The various gears and clutches employed for obtaining the different speeds of the work-spindle and cam-drum *D* are contained in the transmission case *H* which is located at the rear of the machine. All the

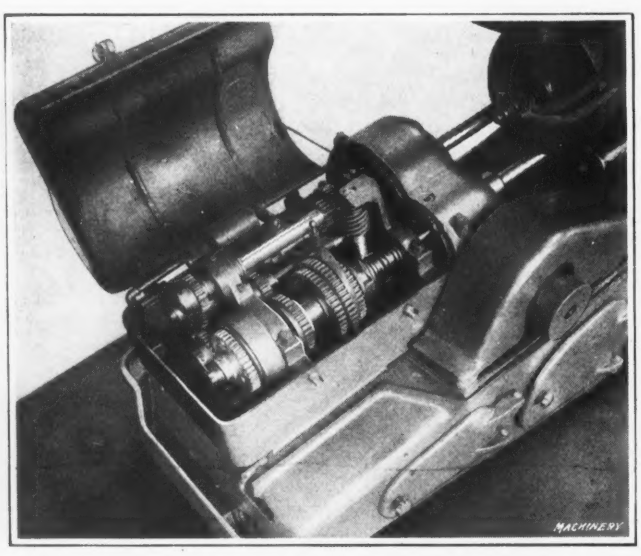


Fig. 3. Transmission Case with Cover lifted, showing Gearing controlling Speeds of Work-spindle and Cam-drum

gears are made of hardened steel, and ample lubrication is provided by a spray system. Fig. 3 shows the transmission case with the cover lifted, from which an idea of the arrangement of the gearing may be obtained. By placing this gearing in a separate box, it is claimed that ideal conditions of adjustment, changing of gears, and accessibilty are secured. The change-gears are placed in the base compartment and are selected by the operator to best suit a given job.

Two work-spindle and two cam-drum speeds are provided, the latter being automatically controlled by trips on the drum. There are flexible connections on the shafts, extending from the transmission case to the main frame, so that perfect alignment between these two units is not essential. Hopper *L* is provided as a receptacle for chips falling from the work and cutting tools. Although the machine is shown equipped with a motor drive, it may also be furnished for driving from a countershaft. The machine is only about 2½ feet wide, so it is convenient for an attendant to operate two or more at one time. The weight of this automatic lathe is 7200 pounds, and the floor space required is about 4½ by 9 feet.

BOSTON ROTARY SURFACE GRINDING MACHINE

The Boston Scale & Machine Co., 100 Ruggles St., Boston 20, Mass., has placed on the market a rotary surface grinding machine illustrated in Fig. 1, which has been satisfactorily used on a production basis for more than a year. An unusual feature of the machine is the method of imparting reciprocatory motions to the head carrying the grinding

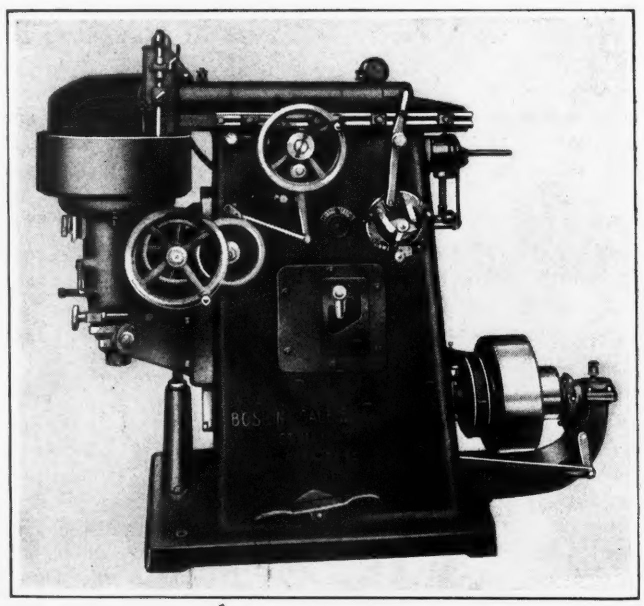


Fig. 1. Rotary Surface Grinding Machine built by the Boston Scale & Machine Co.

wheel spindle. This motion is obtained by oil flowing under pressure, the direction of the flow being controlled by a balanced reversing mechanism. The result is a smooth and even motion convertible instantly from the slowest to the fastest speed and vice versa, or to any intermediate speed. It is stated that this arrangement permits the machine to be used for any length of time at a short stroke on a large number of similar pieces, without producing unevenly worn parts.

Another advantage of this arrangement is the wide range of speeds which may be imparted to the reciprocating head, the minimum speed being one full stroke forward and return, that is, a distance of 17 inches, in ten minutes. This

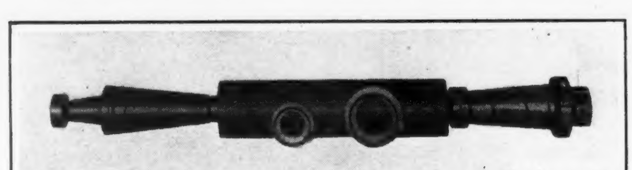


Fig. 2. Grinding Wheel Spindle furnished with a Tapered Bearing at Each End

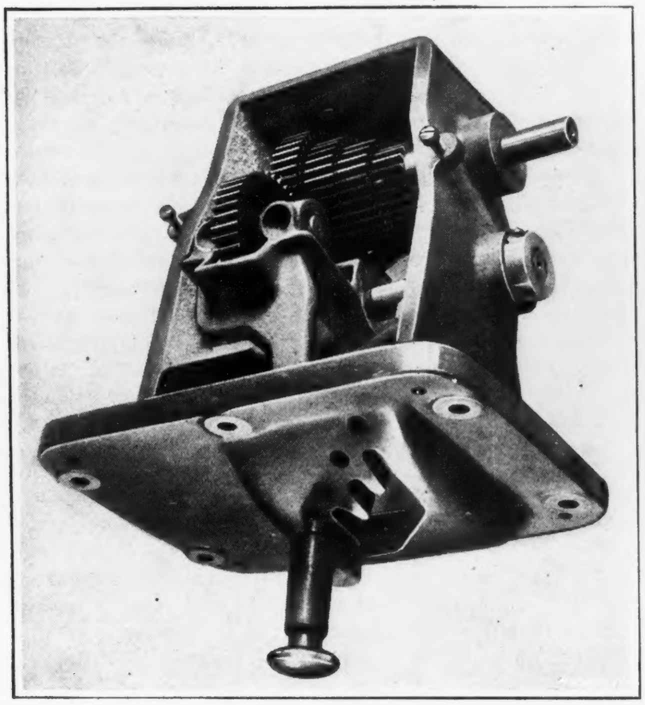


Fig. 3. Change-gear Box controlling Speed of Magnetic Chuck Spindle

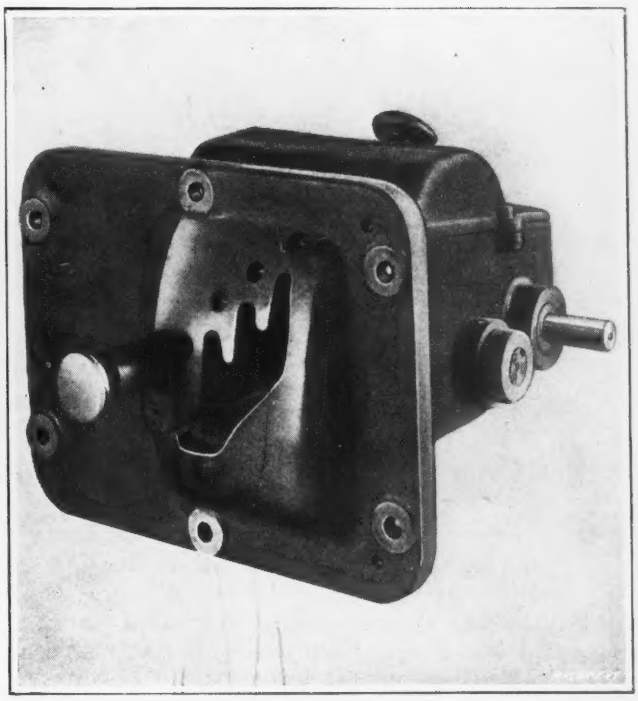


Fig. 4. Change-gear Box, showing Cover permitting Splash-oiling

speed may be converted instantly to the fast speed of ten full strokes per minute or to any intermediate speed, the range being indicated on a graduated sector. The reversing mechanism is of a simple cylindrical rotary type, balanced and not liable to wear. The pump which supplies power for the wheel-head is also of the rotary type, and can develop a pressure of 100 pounds. The working pressure is about 40 pounds, and a relief valve is set at 60 pounds.

The machine is equipped with a 12-inch diameter magnetic chuck supported on the top of a vertical spindle. The speed-cone change-gears that control the speed of this vertical spindle are enclosed in a gear-box, and are so arranged that the gears and shaft bearings are splash-oiled. The gearing and gear-box are arranged as a unit, as shown in Figs. 3 and 4, and can be removed as such from the machine. The grinding wheel spindle is provided at each end with a tapered bearing of liberal dimensions. Provision is made for adjusting each bearing for alignment and wear. A hardened bearing is also furnished to take the thrust obtained in a backward stroke. The grinding wheel spindle is shown in Fig. 2. The chuck spindle has a taper bearing at the upper end to receive thrusts with minimum wear while grinding and to insure a free-running bearing. The bottom bearing of this spindle may also be adjusted for wear and vibration. This spindle can be tilted 10 degrees in either direction. The grinding wheel spindle and the chuck spindles are both one-piece forgings and, together with the change-gears, are made of chrome-nickel steel and heat-treated.

The machine is driven by a 14-inch diameter clutch pulley carrying a 4-inch belt. An automatic feed is provided for the vertical spindle which ranges from 0.0025 to 0.005 inch in increments of 0.00025 inch. This feed may be automatically disengaged at any desired point. The wheel-head may be set to grind a 6½-inch face on any disk up to 16 inches in diameter, provided the work can be held on the chuck. Work up to 17 inches in diameter can be swung inside the water pan. The machine weighs 2800 pounds.

WILMARTH & MORMAN TWIST DRILL GRINDER

Several new features have been added to the "Yankee" twist drill grinder manufactured by the Wilmarth & Morman Co., 1180 Monroe Ave., N. W., Grand Rapids, Mich., the most important of which is the adaptation of the machine for grinding drills with tapered and collared shanks, as

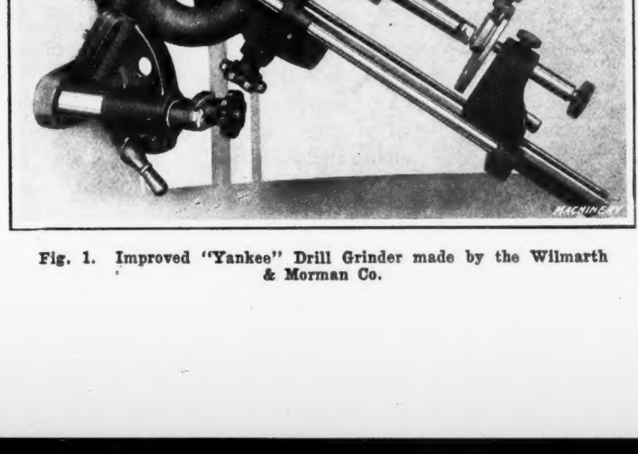


Fig. 1. Improved "Yankee" Drill Grinder made by the Wilmarth & Morman Co.

Fig. 2. Manner of holding Long Straight-shank Drill during Grinding Operation

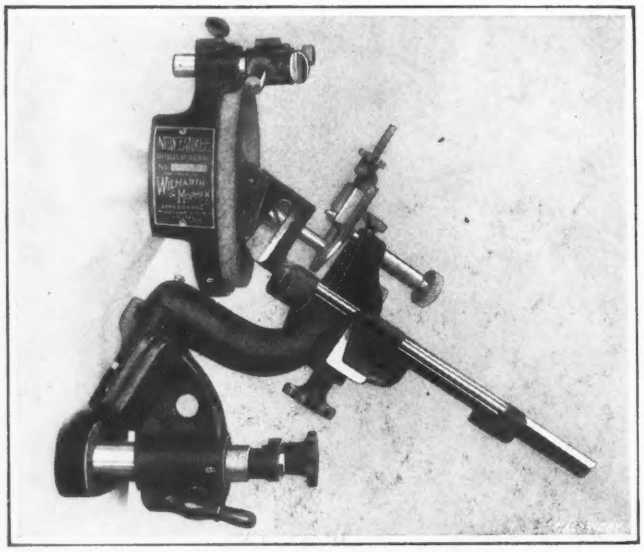


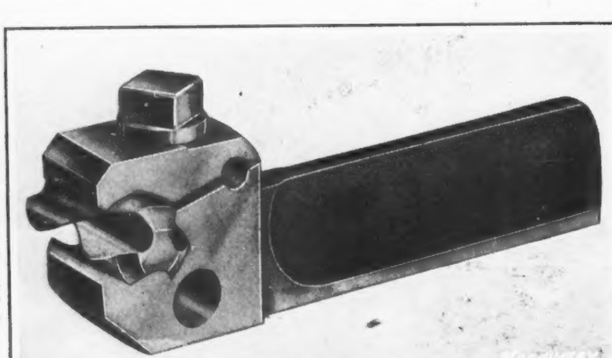
Fig. 3. Grinding Short Straight-shank Drill on "Yankee" Drill Grinder

well as those with straight shanks. The manner in which a long drill with a tapered and collared shank is held during a grinding operation is shown in Fig. 1. In addition to the support at the front of the drill and at the end of the shank, the drill is also supported at the back end of the fluted section by a V-block mounted on a round bar which extends along the holding attachment. This V-block may be slid along the bar to suit drills of various lengths and, when a drill is too short to warrant its use, it may be swung out of the way.

A long straight-shank drill is shown being ground in Fig. 2. It will be noted that the shank end is not supported by the center on the tailstock, as shown in Fig. 1. The method of holding a short straight-shank drill is shown in Fig. 3. In this illustration the V-block support is swung out of the way so that it will not interfere with the tailstock. The machine is made in a variety of styles, nine belt-driven and eight motor-driven, these styles being made up in different combinations from four holders having the following drill capacities: No. 52 to $\frac{5}{8}$ inch; 3/32 to $1\frac{1}{2}$ inches; $\frac{1}{4}$ to $2\frac{1}{2}$ inches; and $\frac{1}{2}$ to 4 inches. Each grinder is equipped with means for obtaining different clearance angles on the work and has a built-in wheel-truing device.

"TWISTO" TOOL AND HOLDER

A tool bit of novel design, which is known as the "Twisto" tool, and a holder for mounting this bit on a machine, have been developed by John H. Montstream, 121 Newington Ave., Hartford, Conn. This tool bit and holder are shown in the accompanying illustration, in which it will be noted that the bit greatly resembles a section of a three-fluted twist drill. It is provided with six cutting edges—three on lands at one end, and three on lands at the other—



"Twisto" Tool Bit and Holder made by John H. Montstream

these cutting edges being arranged helically at an angle that gives an efficient chip rake to each of the cutting lips. In using this bit, the edges may be reground as they become worn. The regular length of a bit is 2 inches, so that there is approximately $6\frac{3}{4}$ inches of cutting lip available.

The tool bit is clamped rigidly in the holder, which is provided with a base that prevents the bit from tilting. This holder is also adaptable for holding circular disk cutters, which are made in various styles and sizes. Such cutters may be mounted on either side of the holder, so that either of the two cutting edges may be used if they are properly ground. The shank is of a rectangular cross-section, $1\frac{1}{8}$ inches long and 9/16 inch wide.

GEM CITY PUNCH PRESS ATTACHMENT

The Gem City Machine Co., Dayton, Ohio, has designed a toggle attachment for application to single-action punch presses for the purpose of adapting machines of this type for the performance of deep-drawing operations, such as generally require the use of a double-action press. The claim is made that this attachment increases the rate of production of a single-action press in deep-drawing operations in some cases as much as 100 per cent, because, whereas two

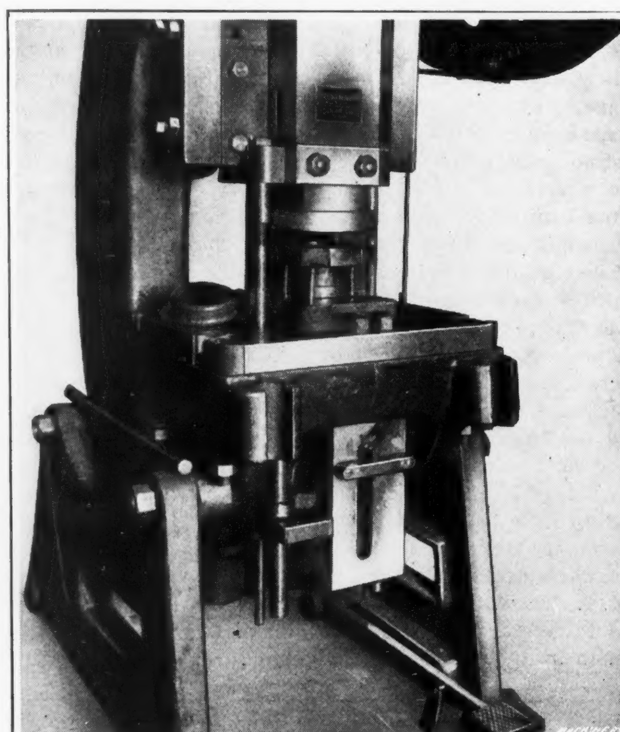


Fig. 1. Punch Press Attachment built by the Gem City Machine Co. for supporting the Pressure-ring in Drawing Operations

or three drawing operations are usually required, only one is necessary on a machine equipped with this attachment. It replaces the springs or rubber pads customarily employed, and operates in such a way that the entire amount of power transmitted to the press is utilized in the actual drawing operations. For this reason it is possible to draw heavier material on a press equipped with the attachment than can be handled on the same press without it.

The device is shown mounted on a press in Fig. 1, while Fig. 2 illustrates it disassembled from the machine. The upper plate *A* is secured to the under side of the punch press frame, and has fastened to it on opposite sides two plates *B* which are provided with cam slots. Plate *A* has also secured to it four guide rods, projecting downward, upon which are slidably mounted the intermediate plate *C* and the lower plate *D*. Plate *D* is connected to the press ram by means of two rods that pass through the intermediate and

top plates and have adjusting nuts at their lower ends. The lower plate is also connected on each side to the intermediate plate by means of toggles which are provided with rollers that run in the cam slot of plates *B*.

In the operation of this device, when the press ram is in its upper position, the intermediate and lower plates are also at the top of their respective strokes, and in close proximity to the top plate. The toggles connecting plates *C* and *D* are then disposed at angles between two plates. Since plate *D* and the ram are connected, as previously mentioned, their movements are in unison when the press is in operation, but during the downward movement of the ram, the intermediate plate remains stationary until the punch comes into contact with the work. Then, if proper adjustments have been made when the press was first set up, the intermediate plate begins its downward movement, and during the remainder of the stroke it maintains the same distance between it and the ram as it holds when the punch first comes into contact with the work. The drawing or pressure ring of the die is connected to the intermediate plate in a manner similar to that employed in the ordinary type of spring drawing die, and the pressure exerted on the work is sufficient to hold the metal. Any tendency of the work to wrinkle while being drawn is immediately resisted by the pressure-ring, because of the fixed relation that exists between the intermediate plate and the ram.

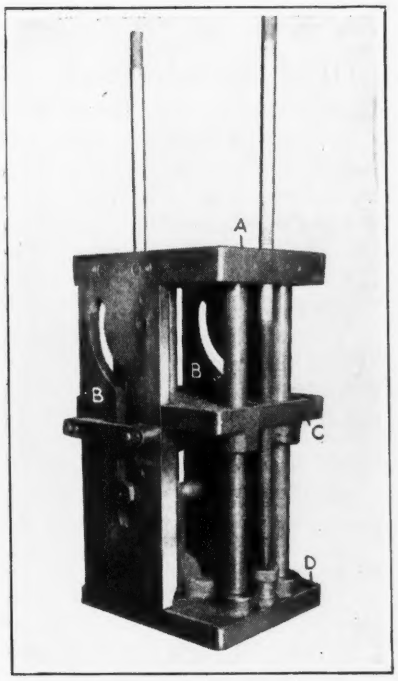


Fig. 2. Attachment with Moving Parts in Positions occupied at End of a Downward Stroke

Any pressure developed is transmitted to the intermediate plate, and from it through the toggles (which are now in vertical positions) to the bottom plate, thus placing the rods connecting the latter to the ram, in tension rather than in compression. The cam-rollers of the toggles move in the straight portion of the slots during the drawing operation. On the upward stroke of the press ram, the bottom and intermediate plates travel in unison, until the rollers reach the cammed portion of the slots in which they operate, whereupon, the toggles begin to assume angular positions and the intermediate plate comes to rest just before the finish of the stroke. The attachment shown in the accompanying illustrations was built for a punch press having a stroke of 3 inches, but it has sufficient capacity for use on presses having strokes up to 6 inches. Its weight is 190 pounds. The application of the device to a machine does not interfere with its use for the performance of piercing or blanking operations.

TOOL-ROOM LAYING-OUT INSTRUMENT

To facilitate the accurate laying out of holes on dies, fixtures, and other work requiring similar precision in machining, preparatory to prick-punching, spotting, and finish-drilling, or for use in locating centers of holes on work mounted on lathes or milling and drilling machines, the tool shown in Fig. 1 was designed by Aldeen & Hillman, 1704 Sixth St., Rockford, Ill. This instrument is also shown in Fig. 2 placed

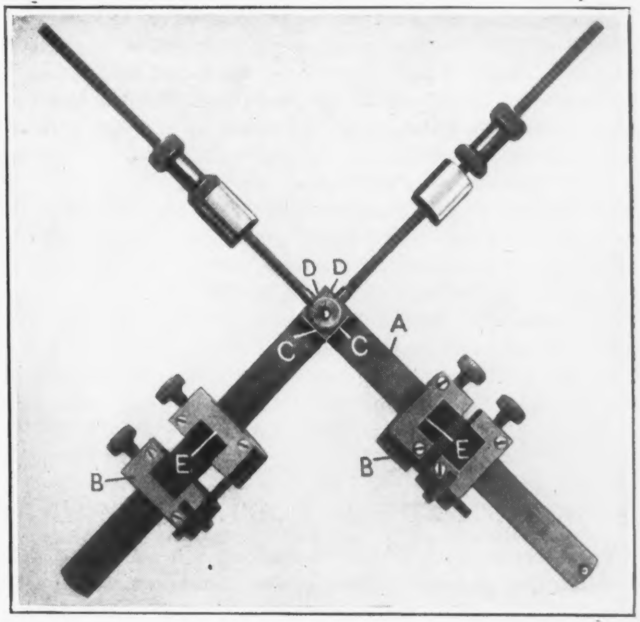


Fig. 1. Instrument designed to facilitate the Accurate Laying out of Holes on Dies, Fixtures, etc.

on a piece of work on which the center of a hole is being located. Reference letters in both illustrations refer to the same surfaces or members of the tool.

It will be seen that the instrument has a right-angle frame *A*, upon the two legs of which are mounted slides *B*. At the junction of the two legs, the metal is considerably thicker than in the legs, and there is inserted a hardened steel bushing for accurately guiding the drill. From this corner of the frame there project two screws in opposite directions to the legs, and upon these screws are mounted clamping members and nuts. Each of the slides *B* consists of two members connected by an adjusting screw, so that after the slide has been set at the approximate distance from the bushing in the frame, the rear member can be clamped on the frame and the front member finely adjusted before it is clamped in position; this arrangement permits the making of accurate settings.

In order to illustrate the method of using this instrument, assume that it is desired to locate the center of a hole on the piece of work shown in Fig. 2, this center being a distance *M* from the finished edge *O* and a distance *N* from another finished edge *P* at right angles to the first, both of these edges being perpendicular to the surface on which the hole is to be located. Gage-blocks of sufficient thickness to equal dimension *M* minus the distance from the bushing center to surface *C*, or 0.250 inch, are then placed on the proper leg of the frame, and the slide on this leg is tightened against the blocks as previously described. A combination

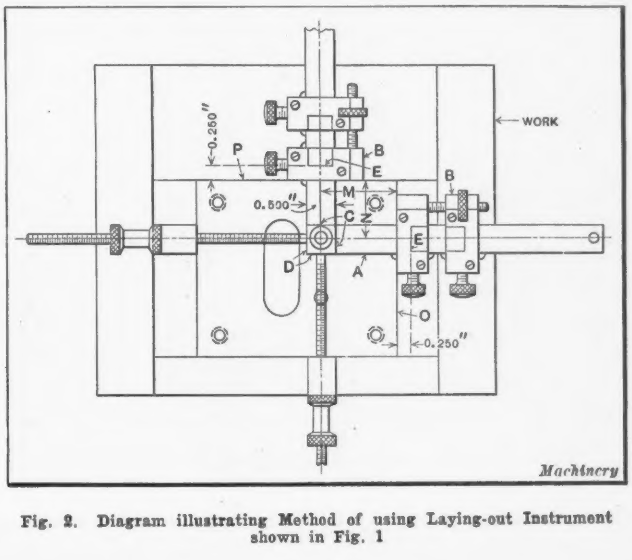


Fig. 2. Diagram illustrating Method of using Laying-out Instrument shown in Fig. 1

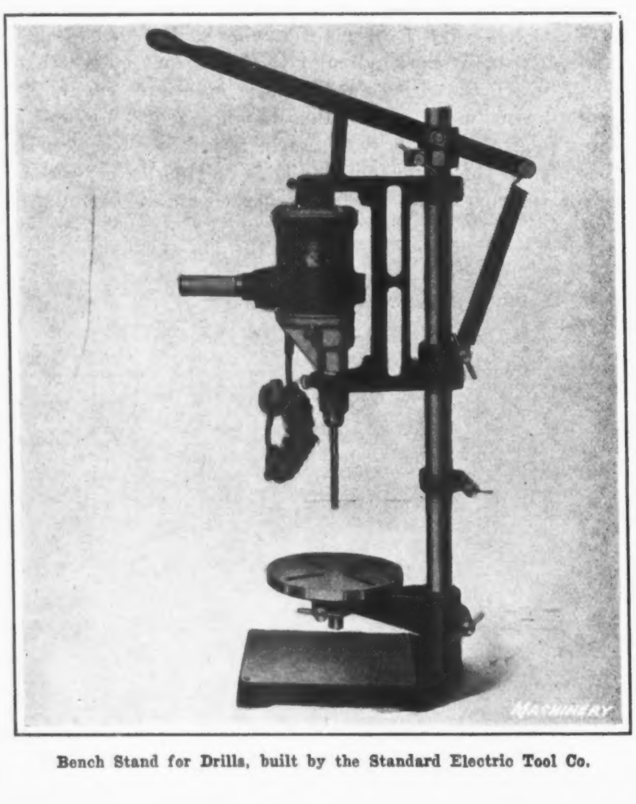
of blocks equal to dimension N minus 0.250 inch is next placed on the other leg, and the respective slide is properly set. The device is then laid on the work and clamped on it by means of the clamping members previously mentioned, after which the hole center is located by drilling through the bushing.

A micrometer can also be used for setting the slides, the measurement being taken from surfaces D on the frame to surfaces E on the slides, 0.500 inch being added to dimensions M and N in setting the micrometer. The bushing in the frame can be removed and replaced by a button to adapt the tool for work on the faceplate of a lathe. Pins are provided at the ends of the frame legs to prevent the slides from being accidentally pushed off. The maximum distance that the front faces of the slides can be set from the center of the bushing is approximately 3⅜ inches.

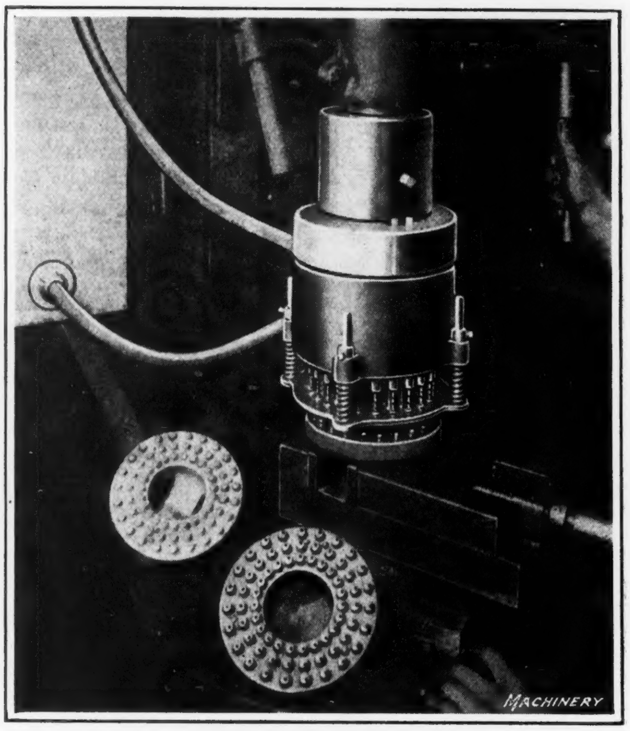
BENCH STAND FOR PORTABLE DRILLS

The accompanying illustration shows a bench stand that permits the portable electric drills manufactured by the Standard Electric Tool Co., Cincinnati, Ohio, to be used as small upright drilling machines. However, the attachment of a drill to one of these stands does not hinder its use as a portable tool, as it can be detached in a few moments. This scheme therefore increases the range of work which can be accomplished by a portable tool, and frequently eliminates the necessity of purchasing a more expensive equipment. For this reason, the stand is especially recommended for use in small shops, but it is also convenient in larger shops in cases where there is not space for the installation of a heavier and bulkier drilling machine.

The stand is made for driving electric drills of ⅜ and ½ inch diameter in steel. It is provided with a quick return and a 9-inch diameter table which is slotted as shown. The distance from the column to the center of the table is 6 inches and the vertical feed is approximately 4 inches. The head attachment on which the drill is clamped can be adjusted to any point on the column, and a clamping collar is furnished for regulating the depth to which a hole is drilled. The table can be swiveled on the column so that work may be placed on top of the base, when this procedure is desirable. The electric drill furnished with a stand may be attached to an alternating- or direct-current lamp socket.



Bench Stand for Drills, built by the Standard Electric Tool Co.



Drilling Gas Burners with a Multiple Drill Head made by the Newman Mfg. Co.

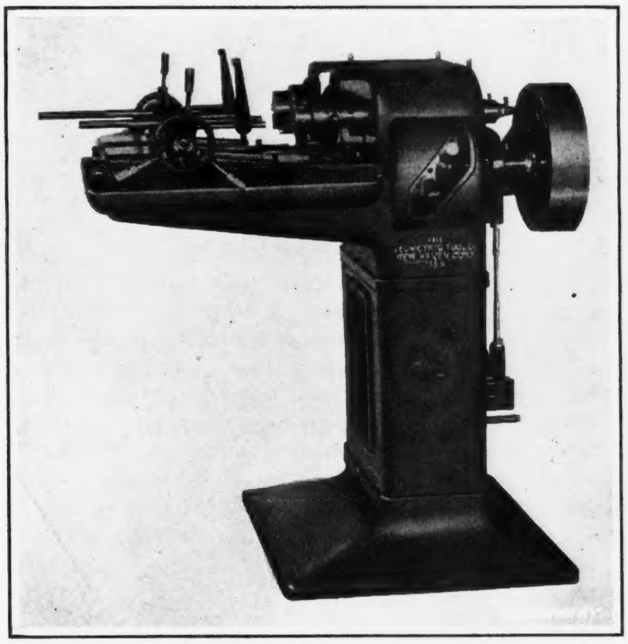
NEWMAN MULTIPLE DRILL HEAD

The accompanying illustration shows a water-cooled drill head provided with sixty-nine spindles, being used for the simultaneous drilling of holes in a cast gas burner. This drill head was made by the Newman Mfg. Co., 717-719 Sycamore St., Cincinnati, Ohio, which makes multiple drill heads of this type with any number of spindles up to 150, according to the requirements of the job on which they are to be used. These drill heads are especially useful in the manufacture of such products as hot water heaters, gas furnaces, etc., because of the amount that they permit the production time to be reduced. They are built to fit standard types of drilling machines or to suit individual requirements.

GEOMETRIC DOUBLE-SPINDLE THREADING MACHINE

In the threading of work on which the operation time is sufficient to chuck and start the threading of a second piece while the first is being completed, it is obvious that a higher rate of production could be obtained on a machine constructed to make this procedure possible. To meet such a condition, the Geometric Tool Co., New Haven, Conn., has developed the ¾-inch double-spindle threading machine here illustrated. A number of threading combinations are possible with this machine; both spindles may be fitted with die-heads for external threading or with taps for internal threading, or a die-head may be mounted in one spindle and a tap in the other for work requiring both an external and an internal thread. The latter combination may also be employed for separate external and internal threading jobs. In order to tap sizes of threads smaller than can be machined with a collapsing tap, the machine may be equipped with a ball-driven reversing tap-holder.

The two spindles are mounted in large bronze bearings and are driven by a single pulley located at the rear, but they can be driven independently by operating the change-gear levers on each side of the machine. Both carriages are fitted with a two-jaw chuck which is operated by a hand-wheel and which can be provided with special bushings or holders to suit various classes of work. An adjustable swinging gage on the side of the carriage provides an accurate means of setting the work for cutting the thread to a pre-



Double-spindle Threading Machine developed by the Geometric Tool Co.

determined length. An adjustable stop on the trip-rod ahead of the carriage governs the opening of the die-head and the length of thread, while a second adjustable stop in back of the carriage controls the closing of the die-head.

The change-gear levers previously mentioned control the spindle speeds independently, and are set to furnish the proper speeds for the threads being cut. The spindle speeds range from 75 to 225 revolutions per minute, and are satisfactory for average work, although they may be varied to suit special conditions. A geared pump forces oil from a reservoir through the spindle and die-head and against the work. When the spindles are equipped with taps, the oil is fed through pipes on the outside of the machine. The tapping range of the machine is for work from 1/8 to 3 inches in diameter when the pitch of the thread is fine, while the machine will thread work of various diameters from 1/4 to 3/4 inch. The greatest length of thread that can be cut at one setting of the work is 8 1/2 inches, but by making a resetting, a length of 14 inches can be cut. The machine may be fitted with a 2 1/4-inch Geometric rotary die-head for cutting fine-pitch threads on brass tubing and work of a similar nature up to a diameter of 2 1/4 inches. The net weight of the machine is 820 pounds.

"PECORP" DRILLING MACHINE

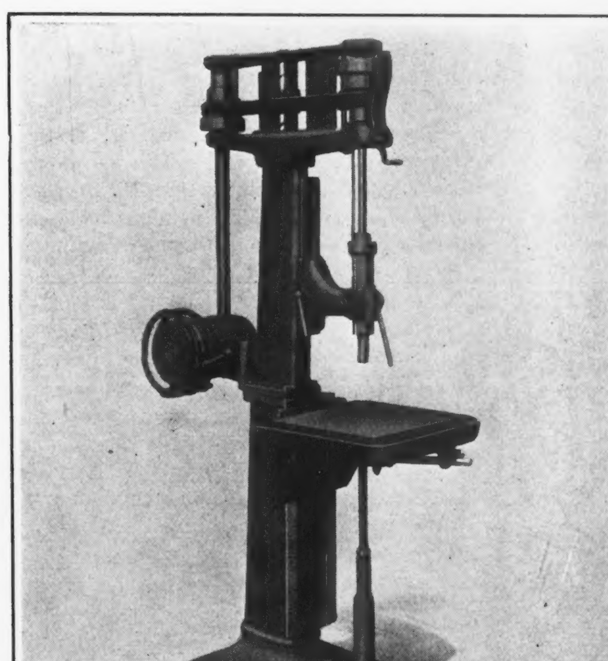
The Providence Engineering Corporation, 521 S. Main St., Providence, R. I., is now building the "Pecorp" upright drilling machine shown in the accompanying illustration, which is made ball bearing throughout. It is claimed that belt troubles are eliminated because the driving belt is straight and requires no adjustment for different speeds. The spindle is carried by ball bearings and made self-oiling. It is machined from a tough steel and finished to size by grinding. A reservoir in the sleeve contains a sufficient quantity of oil to lubricate the spindle for one week, which greatly simplifies the work of keeping a machine of this type in efficient working condition. The sleeve key runs its entire length, and rack teeth are cut directly in the steel sleeve.

The head carries the quick-change belt-shifting device, and it is stated that the complete range of speeds may be obtained in less than two seconds, the belt being shifted by forks arranged to have reciprocating movements, which hug the pulleys closely and prevent the belt from rolling over. They are operated by a crank-handle in front of the cone pulley, and directly beneath a dial showing the proper speeds for the various sizes of work. One complete turn of this handle will give any of the available speeds. On each turn, the belt shifters are positively locked in place assuring proper tracking of the belt, and no wear due to the belt dragging on improperly placed shippers.

The four-step cone pulleys are so mounted with their own self-contained ball bearings that they can be removed without disturbing adjacent parts. This unit construction is a characteristic of the machine. Slack in the horizontal belt is automatically taken up by two ball bearing idlers so arranged that they adjust themselves to the load as it is applied to the belt, this result being accomplished in such a way that the belt is only under tension when the load is applied. The table is elevated and lowered by a telescopic screw geared to a crank-handle shaft.

Tight and loose pulleys, on a horizontal shaft with a hand belt shift, supply power through a pair of bevel gears to the vertical shaft, the gears being inclosed in a substantial case so that they can run in a bath of oil. The vertical shaft and its gear are so mounted that they can be removed from the machine without tearing down the driving mechanism. According to requirements of the consignee, this machine can be arranged as a single-purpose drilling machine with one spindle speed; as a plain machine with four rates of speed available for the spindle; or as a tool-room machine with additional changes of speed. Automatic power feeds can be arranged on any spindle, alternating with built-in tapping attachments. Spindle speeds as high as 3500 revolutions per minute can be utilized on specially constructed machines. Provision can be made for motor drive with either a vertical or a horizontal motor.

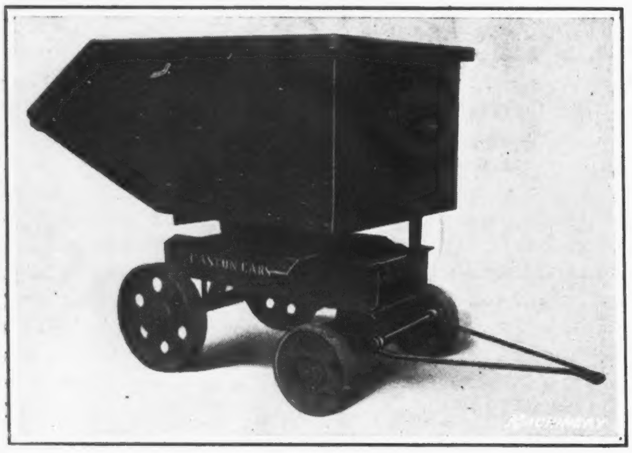
The patterns, tools, jigs, and materials for the manufacture of drilling machines formerly built by Arthur C. Mason, Inc., of Hawthorne, N. J., have been acquired by the Providence Engineering Corporation, and these machines are now included in the "Pecorp" line of drilling machines. In MACHINERY for May, 1918, was illustrated and described the Mason high-speed sensitive drilling machine which is made for handling drills over a range of from No. 80 to 3/16 inch, inclusive. The larger machine, shown in Fig. 1, has a capacity for drills from 1/8 to 5/8 inch inclusive. Both of these machines are now built in Providence, and a sales office is maintained at 5 Nassau St., New York City.



"Pecorp" Upright Drilling Machine manufactured by the Providence Engineering Corporation

EASTON SCOOP CAR

The accompanying illustration shows a scoop type of car built by the Easton Car & Construction Co., 50 Church St., New York City, which is equipped with flat-tread wheels so that it is particularly adapted to the handling of iron and steel chips, small forgings and castings, bolts, etc., in machine shops; and coal, coke, and cinders in and around boiler houses and foundries. This car can be readily pulled about by one man, or it may be attached to the rear of an industrial truck and hauled from place to place as a trailer. The body of the car is mounted on a structural steel turntable, so that it can be turned around and dumped from any

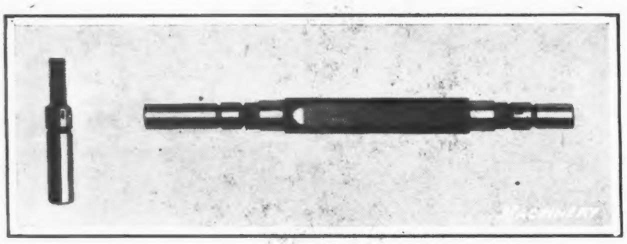


Scoop Car built by the Easton Car & Construction Co., for hauling Chips, Small Forgings and Castings, etc.

one of the four sides. The front axle swivels, being provided with a machined cast-iron ball-bearing turntable that permits the car to be turned around in a circle having a radius of practically its own length. The low loading height of the car is especially convenient for hand loading. Its capacity is 27 cubic feet.

JOHANSSON REPLACEABLE-END PLUG GAGE

A new type of tolerance plug gage has recently been placed on the market by C. E. Johansson, Inc., Poughkeepsie, N. Y., the main feature of which is that the ends are replaceable. By means of this provision when the "Go" end becomes worn, it can be replaced, and as it is unnecessary to throw away the unworn or "Not Go" end and its holder, the useful life of a gage may be extended indefinitely by simply replacing the worn end as the occasion demands. The ends are securely locked in place so that they do not become

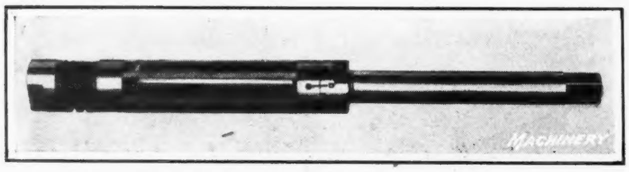


C. E. Johansson Tolerance Plug Gage with Ends which may be replaced when Worn

loose while being used. This type of tolerance plug gage is being made in sizes ranging from 1/8 to 47/64 inch.

FOSTER-JOHNSON ADJUSTABLE REAMER

An adjustable general-purpose reamer which can be readily and accurately expanded or contracted, and which is sold under the trade name of Kylin, has been developed by the Foster-Johnson Reamer Co., Elkhart, Ind. This reamer is

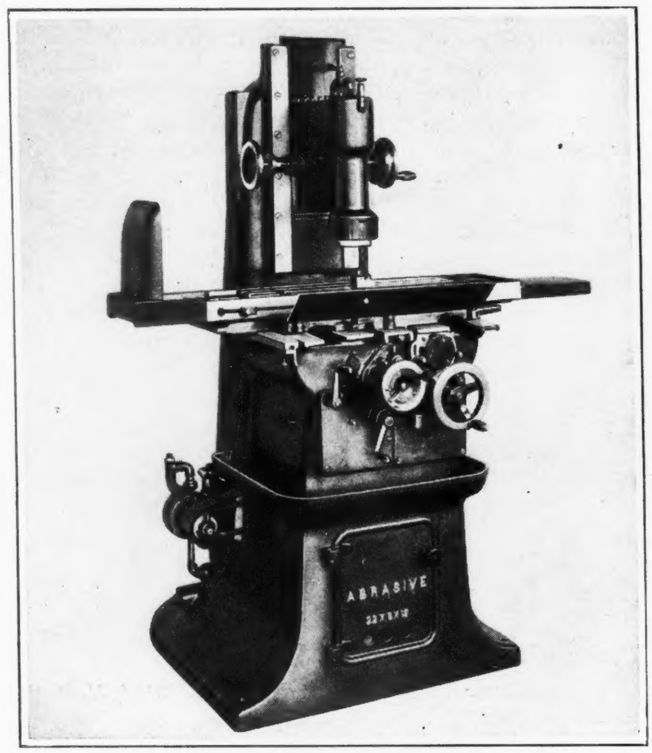


Kylin Expanding and Contracting Reamer with Micrometer Adjustment, made by the Foster-Johnson Reamer Co.

expanded or contracted by operating a single adjusting nut, and the amount of expansion or contraction can be read directly on the tool by means of micrometer graduations. A helical spring at the front end affords an easy and accurate adjustment. It is stated that by incorporating this spring in the construction of the reamer, a very high quality of finish is imparted to the work. The reamer is suitable for many classes of work, being made in thirteen sizes, of which the nominal diameter ranges from 5/8 to 1 1/2 inches, the smaller sizes having four blades, and the larger ones, six.

ABRASIVE SURFACE GRINDING MACHINE

A sensitive vertical-spindle surface grinding machine suitable for tool-room use and for certain classes of production work such as the squaring of shaft ends on centers and the surfacing of small pieces held by a magnetic chuck, has been



Vertical-spindle Surface Grinder for Tool-room Work and Certain Classes of Production Work, built by the Abrasive Machine Tool Co.

developed by the Abrasive Machine Tool Co., East Providence, R. I. It is especially suited to resharpening pilot dies by employing a cup-wheel, the claim being made that a wheel of this style is more efficient than a disk wheel for such an operation. The general features of the machine are the same as those of the horizontal-spindle type of surface grinding machine brought out by the same concern during the latter part of 1917 and of which mention was made in the December number of MACHINERY for that year.

The wheel-spindle is carried on radial thrust bearings, and all high-speed shafts are likewise mounted on ball bearings. The adjustment of the wheel-head is accomplished by means of a screw actuated by a worm and worm-wheel. Two handwheels are provided for this adjustment, one for obtaining a fine feed, which is provided with 0.00025-inch grad-

uations, and another for securing rapid movements of the head. The gears for operating the table and the cross-feed are in a self-contained unit in which the gears and clutches run constantly in a bath of oil. All belts and other moving parts are enclosed, so that the safety of the operator is insured, and all bearings are carefully guarded against the admission of dust or water. The machine can be equipped with a countershaft for a belt drive or with a concealed motor drive. The longitudinal and transverse feeds of the machine are automatic, the maximum longitudinal movement being 22 inches and the transverse movement, 8 inches. The vertical adjustment of the grinding wheel head is 10 inches, and wheels up to 5 inches in diameter may be used.

DIAMOND SURFACE GRINDING MACHINE

Rigidity of the essential parts of a machine tool depends quite as much upon the distribution of mass and the maintenance of a condition of dynamic balance as upon mere weight. In following out this principle in the design of the Type C surface grinding machine shown in Figs. 1 and 2, the Diamond Machine Co., Providence, R. I., decided to concentrate a great deal of metal in the vicinity of the wheel-spindle bearing adjacent to the grinding wheel. This machine has a capacity for grinding work up to 24 inches long, 10 inches wide, and 8 inches high, and so it is suitable for the grinding from the rough of many pieces that would otherwise need to be planed and subsequently finish-filed or scraped. The machine is equipped for feeding coolant to the work, which after having served its purpose, flows from the table through channels into a separate compartment within the base of the machine where the grit settles. The clear liquid is pumped back to the "spreader" or special form of nozzle which directs the stream to the point of grinding. This coolant keeps the wheel from becoming loaded with metal particles and improves the character of the ground surface.

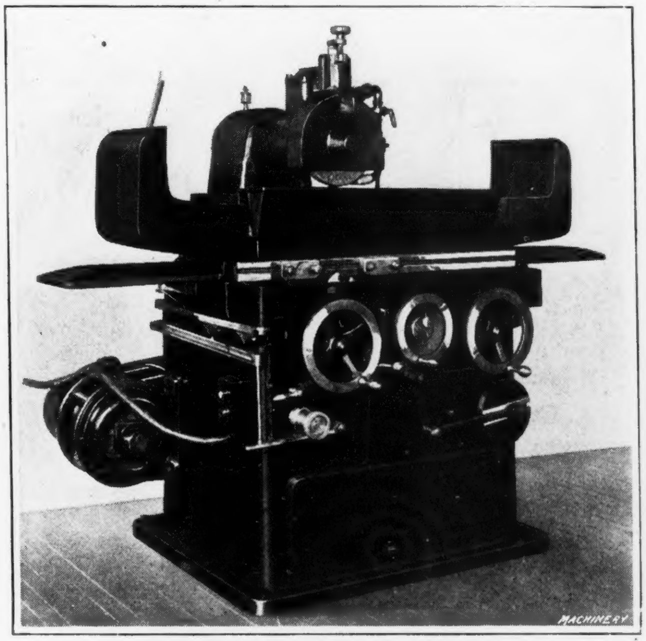


Fig. 1. Surface Grinding Machine recently developed by the Diamond Machine Co.

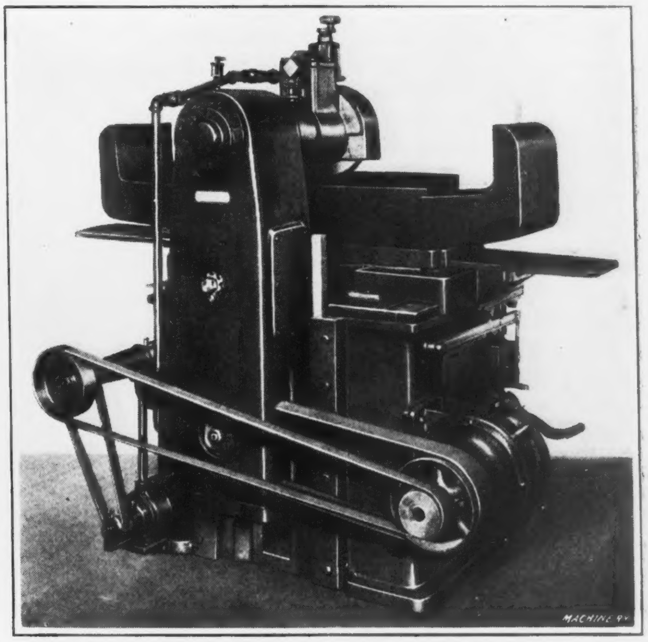


Fig. 2. Rear of Machine illustrated in Fig. 1, showing Integral Construction of Wheel-head and Column

An unusual feature of this machine is that the wheel-spindle head is cast integral with the vertical column, and so the combined column and head, rather than the head alone, is adjusted up and down to suit different thicknesses of work. One of the advantages obtained by this arrangement is a large surface area for the ways of the vertical slide. Another feature of the machine, which has been previously referred to, is the construction of the main spindle bearing nearest the grinding wheel. This is a composite plain and ball bearing, which combines the advantages of both types. The plain bearing consists of a floating bushing adjacent to the ball races. It is claimed that by constructing the wheel-head in the manner described, and by employing the double bearing, all chatter is eliminated and a high quality of finish is obtained on the work. There is no appreciable wear on the floating bushing because the ball bearing takes care of radial thrusts. The rear end of the spindle is also provided with a ball bearing. The driving pulley of the spindle is placed between the two spindle bearings and nearer the rear bearing, so that any vibration of the driving belt will not cause corresponding vibration of the spindle.

The handwheels for horizontal and transverse adjustments of the table and vertical adjustments of the wheel-head are arranged side by side at the front of the base for the convenience of the operator. Longitudinal travel of the table is obtained by operating the left handwheel, the table being moved about 2 inches per revolution of the wheel. The table is moved transversely 0.500 inch per revolution of the central handwheel, and the handwheel at the right is used for raising or lowering the wheel-head, the latter being moved a distance of 0.100 inch per revolution of the wheel. The rims of the central and right handwheels have a graduation for each 0.001-inch movement of the table and wheel-head, these graduations being so widely spaced that the operator can readily adjust these members to 0.0001 inch. Ball thrust bearings are provided on both the horizontal and vertical adjusting screws.

The ways on which the adjustable members slide are completely covered by metal guards to prevent their injury from the collection of abrasive dust or gritty water. The longitudinal travel of the table is accomplished by means of a train of belt-driven gears, and reversal is effected by a single shifting belt. A simple device insures a complete shifting of the belt at the end of each stroke. Momentary pressure upon a trigger causes the table to stop at the completion of any stroke already begun, and the table travel may be stopped instantly at intermediate points by disengaging the clutch connected to the left handwheel. The transverse table feed is automatic and adjustable from 0.001 inch to 0.020 inch. The feed takes place at both ends of the table travel and can be made in either direction. There is an automatic stop for this feed, which can be set to disengage at any desired point.

In order to give an idea of the capacity of this machine,

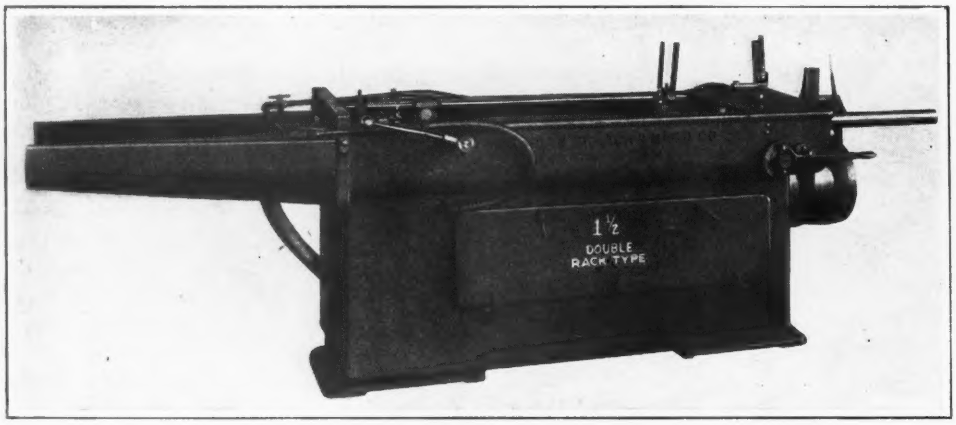


Fig. 1. No. 1½ Double-head Rack-operated Broaching Machine developed by the American Broach & Machine Co.

it is stated that a cut 0.234 inch deep and 1/16 inch wide has been taken, the total cross-sectional area of the cut being 0.015 square inch. However, such a cut is not recommended, because the average grinding wheel would wear away too fast for economy, this case being cited only to show that the machine is claimed to surpass the capabilities of modern grinding wheels. The machine illustrated is motor-driven, but it can be arranged for driving from a countershaft when such a method is preferred.

NO. 26 LEA-SIMPLEX SAW

The Earle Gear & Machine Co., Stenton and Wyoming Aves., Philadelphia, Pa., has recently added a larger sized machine to the line of Lea-Simplex cold saws of its manufacture. This new machine is known as a No. 26, and it takes a 26-inch diameter saw blade. It has a capacity for cutting 11-inch round or 10-inch square stock, and 20-inch I-beams. As with other saws built by this concern, the new size can be furnished with either a belt or motor drive. The weight of the machine is about 4500 pounds.

AMERICAN DOUBLE-HEAD BROACHING MACHINE

A description of the No. 1½ rack type broaching machine manufactured by the American Broach & Machine Co., Ann Arbor, Mich., appeared in the October, 1920, number of MACHINERY. The accompanying illustration shows a machine of the same general construction, except that it is provided with two sliding heads instead of only one. The new machine is known as the No. 1½ double-head broaching machine. The sliding heads are made from solid billets of steel, and they are equipped with a central broaching block that permits the operator to bring the head into accurate alignment for central broaching.

The machine is so arranged that one head may be operated alone, the same as on a single-head machine. When both heads are being used, the stroke can be so adjusted that both heads will broach the same length of work. An automatic brake is provided to arrest the momentum of the driving mechanism as soon as the heads come into their stopping position. The distance from center to center of the bores in the face of the machine is 9 inches, these bores being 5 inches in diameter. The height from the floor to the center of the bores is 30½ inches. The machine is adapted to the use of broaches of various lengths up to 50 inches, and its weight is 2700 pounds.

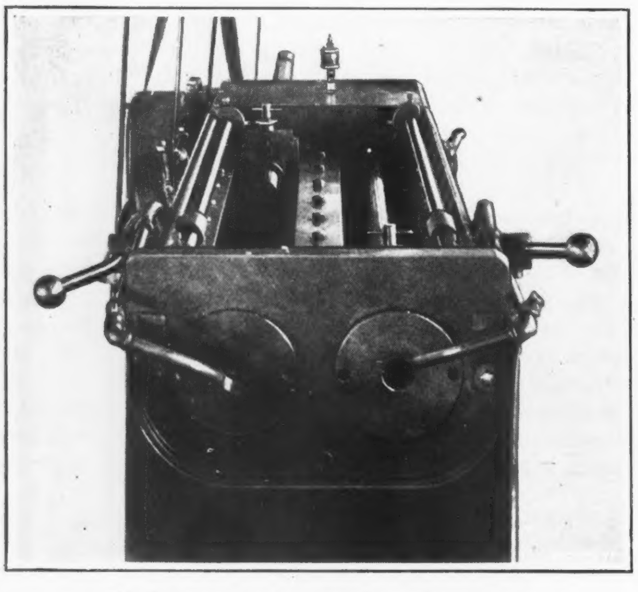
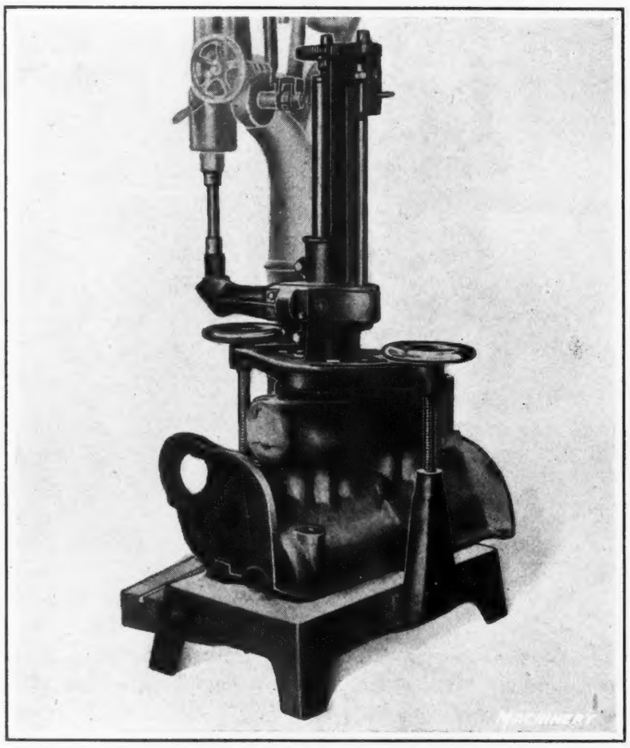


Fig. 2. View showing Top of Broaching Machine



Machine developed by the Storm Mfg. Co. for reboring Gasoline Engine Cylinders

STORM CYLINDER REBORING MACHINE

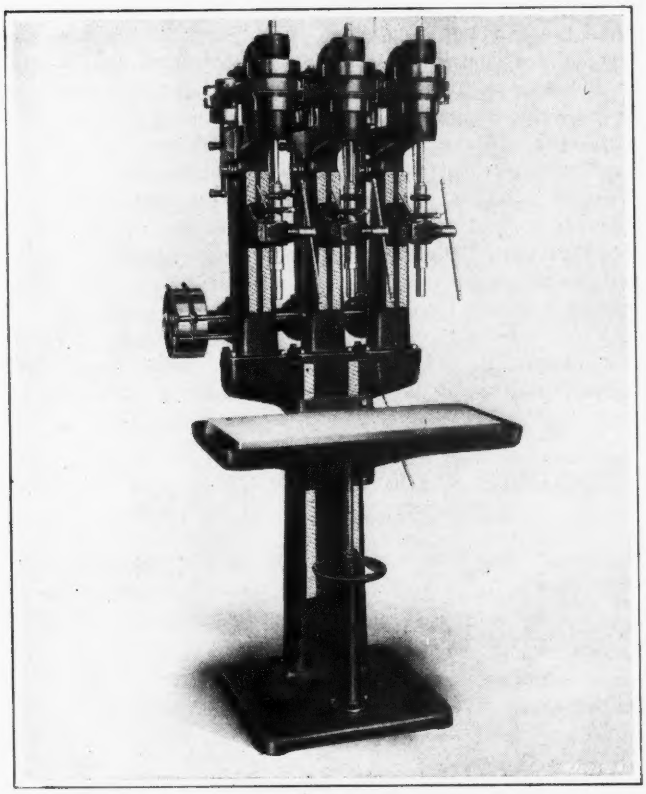
The Storm Mfg. Co., Sixth Ave. and 4th St. S., Minneapolis, Minn., has developed the Type M cylinder reboring machine which is shown in operation in the accompanying illustration, this machine being driven from the spindle by a drilling machine. The main body is a one-piece casting which supports the boring-bar and the feeding and driving mechanisms. The boring-bar is hollow, made of carbon steel, hardened and ground, and has a travel of 14 inches. It is rotated by means of spiral gears and fed through an internal screw and an upper feed gear. The cutter-heads supported by the bars cannot be seen in the illustration, but they are of the Storm patented six-cutter type having a universal adjustment so that they may be set for boring to any desired size within the capacity of the machine.

A valuable feature of this tool is that it is adapted for different methods of driving. It is regularly furnished with

a connection for a drilling machine as illustrated, but it can also be furnished with a pulley for a belt or motor drive, or it may be driven by hand through the use of a double-end wrench. It will be noted that the machine does not come directly under the spindle of the drilling machine but to one side, so that it does not interfere with the machining of work on the drilling machine. The tool is back-geared so that it may be used in connection with an ordinary 20-inch drilling machine, whether the machine is of the back-geared type or not. The machine may be taken off the base for reboring automobile cylinders without removing the engine from the chassis. It will rebore holes 2⅝ to 6½ inches in diameter, and weighs 300 pounds.

EDLUND DRILLING MACHINE

In the April, 1919, number of MACHINERY was published a description of a No. 2B sensitive drilling machine built

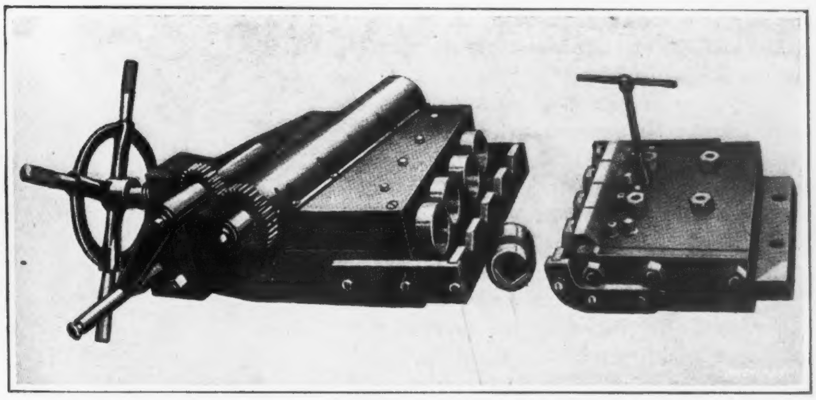


No. 1B Ball-bearing Sensitive Drilling Machine manufactured by the Edlund Machinery Co., Inc.

with from one to six spindles by the Edlund Machinery Co., Inc., Box 57, Cortland, N. Y. The accompanying illustration shows a No. 1B ball-bearing sensitive drilling machine, built by the same concern along the general design of that previously described, and in combinations of from one to four spindles. On the new machine, some of the principal dimensions are as follows: Distance from the center of the spindles to the face of the column, 7 inches; maximum distance between spindle nose and table, 30 inches; vertical traverse of spindle, 3½ inches; vertical traverse of arm, 10 inches; and vertical traverse of table, 17 inches.

MILLER & CROWNINGSHIELD MULTIPLE-SPINDLE INDEX-CENTERS

Multiple-spindle index-centers designed to permit the rapid fluting and squaring of taps, reamers, etc., have been placed on the market by Miller & Crowningshield, Greenfield, Mass., and are shown in the accompanying illustration. The device is made with one, three, four, five, six, or eight spindles, all of which rotate in the same direction. The spindles are spaced closely, so that the several pieces of work will be held in as small a space as possible, and they are connected by equalizing levers that allow a variation of about 3/16 inch in the length of the work being milled. The spindles have tapered holes, and a drift is furnished to interchange centers. All spindles are tightened simultaneously by operating a single handle.



Multiple-spindle Index-centers made by Miller & Crowningshield for Use in fluting and squaring Taps, Reamers, etc.

Any number of flutes from one to twenty can be machined on work mounted on these centers, the proper indexing being obtainable by changing a spur gear. The indexing of all the different spindles is accomplished by turning a handle. In squaring and fluting work with only four flutes, no gearing is required, as one revolution of the index handle turns the spindles a quarter of a revolution. The tail block is separate from the head block and it is made in two styles, one solid, and the other having a separate vertical adjustment for each center. Both types have the same interchangeable tail-centers, which can be readily replaced if they become broken or worn out.

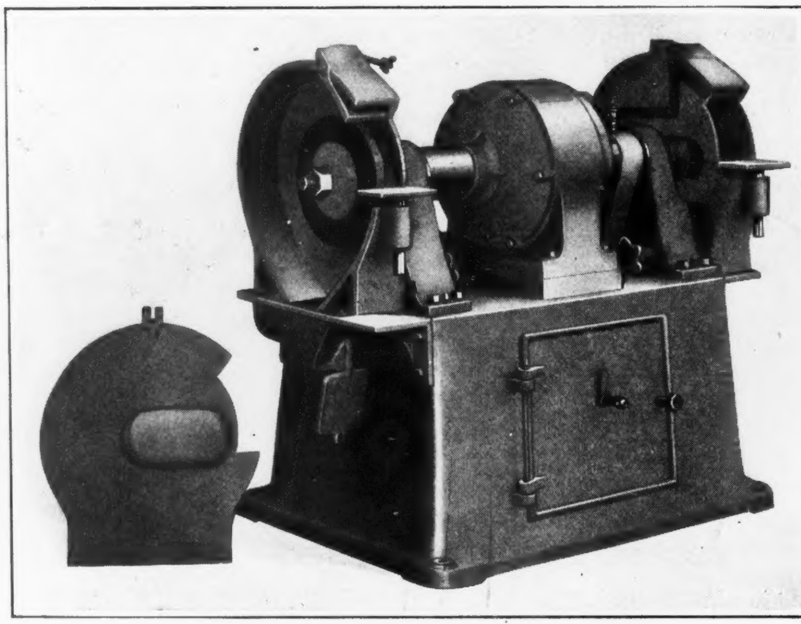
BARRETT-CRAVENS INDUSTRIAL TRACTOR

The chassis of a gasoline-driven tractor known by the trade name of "Powerox" and which has been designed and built by the Barrett-Cravens Co., 171 N. Ann St., Chicago, Ill., for heavy-duty hauling in factories, between shops, etc., is shown in the accompanying illustration. This chassis may be fitted with various types of bodies for carrying a load of 3000 pounds; and by the use of trailers, a load of 40,000 pounds can be drawn. In an equipment of this type, compactness of design is desirable, and in the development of the tractor attention was given toward this end, the overall dimensions being about 8 by 4 feet. The wheel-base is 5 feet, and the tractor can turn in a circle having a radius

Chassis of Industrial Tractor built by the Barrett-Cravens Co.

of 10 feet. Every part is of a standard make, and the entire unit is built to 1½-ton truck specifications.

The tractor is furnished with a 25-horsepower engine having four cylinders cast en bloc, a removable cylinder head, enclosed valves, a circulating air pump, a thermo-siphon cooling system, a speed governor, and a high tension magneto with fixed spark. The engine, clutch, and transmission are located under the driver's seat. The radiator is placed at the rear of the engine; it is spring-mounted and is enclosed in a heavy steel plate housing. Power is applied to the rear wheels through a worm-gear driven axle of the fully enclosed type. The transmission is of the selective type, with three speeds forward, one reverse, and a standard truck control. Constant-mesh gears are used in place of the sliding type, thus eliminating clashing and other troubles experienced with sliding gears. Speed changes are made by the engagement of special jaw clutches.



Heavy-duty Dry Grinding Machine built by the Marschke Mfg. Co.

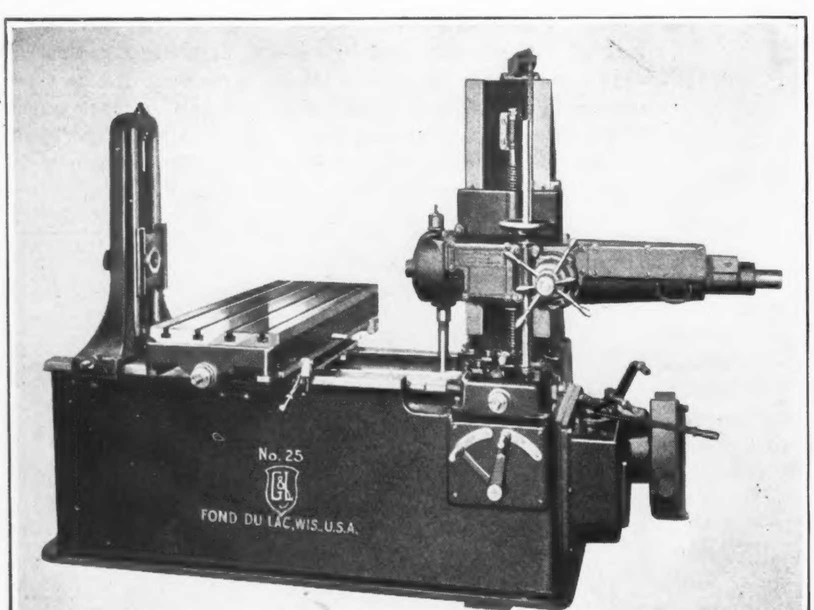
It will be noted that the wheels of this tractor are cast solid with convex faces, and that there are no projecting hubs. The employment of wheels of this type eliminates scraping of doors, machines, etc., as the tractor passes through the shop. The frame of the chassis is constructed of 4-inch channels, and all rivets are hot driven. Solid rubber tires of the pressed-on truck type are used, having a diameter of 20 inches. The speed of the tractor is regularly from one to ten miles per hour, but this may be increased by adjusting the governor.

MARSCHKE DRY GRINDER

A heavy-duty dry grinding machine equipped with two 18- by 3-inch wheels has just been developed by the Marschke Mfg. Co., 1815-1831 Madison Ave., Indianapolis, Ind. This grinder is especially suitable for snagging castings and for other general foundry grinding operations. The wheel hoods are adjustable, so that the wheel may always be close to the front of the hoods; and the spark plates and steadyrests are automatically adjusted with the hoods, when the latter are positioned through the medium of the handwheel. This machine may be furnished with or without an exhaust fan; when the exhaust is supplied, it is placed in the base and driven by a chain. The motor starter is mounted directly on the door of the base, and the starting handle may be seen in the illustration. The hood supports are provided with openings that permit the heavy refuse produced in grinding brass parts to fall into receptacles, so that only the dust is taken off through the blower. Provision may be made for driving the machine by either alternating or direct current. The motor is entirely enclosed and an oil-switch starter is furnished. The speed of the grinding wheel spindle with no load is 1200 revolutions per minute, and with full load, approximately 1160 revolutions per minute. The weight of the alternating-current machine is 2200 pounds, and that of the direct-current machine, 2300 pounds.

GIDDINGS & LEWIS BORING, DRILLING AND MILLING MACHINE

A No. 25 table type horizontal boring, drilling, and milling machine which has been recently developed by the Giddings & Lewis Machine Tool Co., Fond du Lac, Wis., is here illustrated. Several of the points of interest in connection with this machine are as follows: It is driven by a constant-speed pulley drive; an independent reverse is provided for both speeds and feeds; micrometer dials are furnished for all adjustments; a quick-return pilot and worm-gear are supplied at the operating end of the headstock; a change-gear quadrant facilitates thread cutting; the spindle and table are driven through helical gearing; the spindle pilot is controlled by a quick-operating clutch; and the table is equipped with adjustable automatic trips.



No. 25 Table Type Horizontal Boring, Drilling, and Milling Machine built by the Giddings & Lewis Machine Tool Co.

The reversible friction clutch and all speed and feed gears run in baths of oil, and all high-speed shafts are equipped with ball bearings. An auxiliary table of the exact height of the platen can be furnished to assist in supporting large work, this table being adjustable longitudinally and rigidly anchored to the bed of the machine. For angular work a plain hand- or power-feed revolving table can be supplied, which is 24 inches in diameter and graduated in ½ degrees.

A star-feed facing attachment can also be furnished to face parts up to 18 inches in

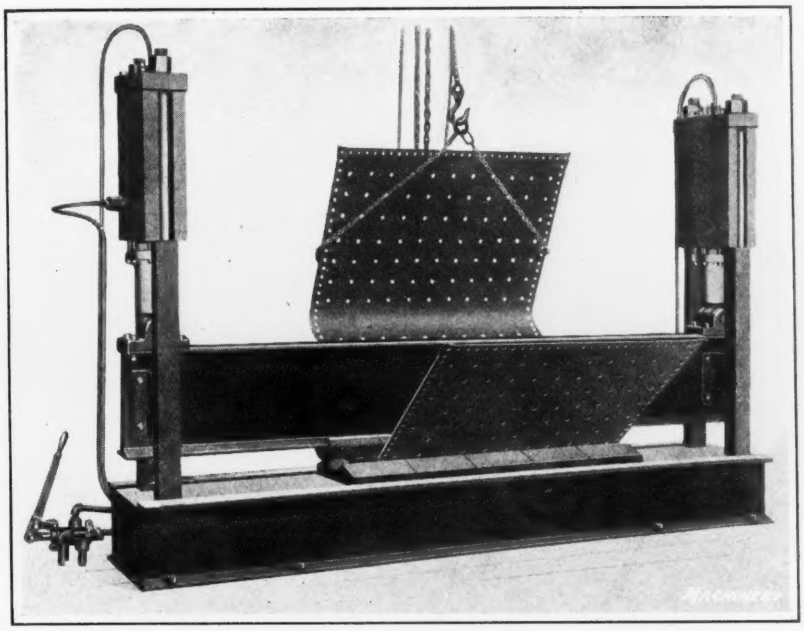


Plate Bending or Straightening Press built by the Houston, Stanwood & Gamble Co.

diameter. This device is regularly bolted and keyed to the spindle sleeve, but it can be arranged to be fastened to the spindle or to a boring-bar. When fastened to a bar, it may be used on either side of the piece being machined. Some of the principal dimensions of the machine are as follows: Diameter of spindle bar, 2½ inches; longitudinal travel of spindle, 13½ inches; maximum distance from table to center of spindle, 20 inches; distance from face of spindle to boring-bar support, 48 inches; size of table, 18 by 48 inches; transverse travel of table, 33 inches; and longitudinal travel of table, 30 inches. The approximate weight of the machine is 6300 pounds.

"THOR" ROTARY WIRE BRUSH

The Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill., has developed a "Thor" rotary wire brush for use on the No. 71 portable pneumatic grinder or on the No. 6 electric grinder manufactured by this concern. This attachment permits the use of the No. 71 grinder with an emery wheel, and by making a few changes, the brush attachment can be quickly added. The wires of the brush are all of equal length, interchangeable and made of specially treated steel. The concave wooden back is fitted inside of a metal cover and secures the brushes in position, the arrangement allowing the wires to bend under pressure without breaking. The brushes are particularly useful for removing paint, rust, scale, dirt, etc., in such work as cleaning steel cars, automobile bodies, steel frames, tank cars, foundry castings, and sheet metal. The brush wires can be replaced when they become worn.

HOUSTON, STANWOOD & GAMBLE PLATE PRESS

The Houston, Stanwood & Gamble Co., Cincinnati, Ohio, has recently placed on the market the plate press here illustrated, which is especially intended for use in boiler or tank shops or other plants having plate or structural steel work to be bent or straightened. The machine has a cross-beam connected to a ram at each end by bearings having a swivel pin. This arrangement gives the beam flexibility and allows it to adjust itself to any unevenness of the work. The frame consists of heavy uprights bolted through cylinders at the top and through a reinforced base casting at the bottom. The upper sectional dies are attached to the beam of the machine in a simple manner, and the lower dies are placed on the base and aligned with the upper ones by means of the channel irons which reinforce the base and extend above the latter for that purpose.

The operating lever for controlling the working and return strokes of the cylinders is located in a position convenient to the operator. The machine is built in various sizes and capacities, and for ram operation by city or other water pressure or compressed air, whichever is available in the plant. By providing suitable dies on the machine, angle-irons can be bent when they are placed back to back. From reference to the illustration it will be apparent that the cross-beam is returned to its upper position without the use of an auxiliary ram.

MASSILLON TRIMMING PRESSES

The Massillon Foundry & Machine Co., Massillon, Ohio, has brought out a line of trimming presses on which the principal feature is a new type of clutch on the driving shaft that is non-repeating and fool-proof. It marks a radical departure in clutch design, and is fully patented. These presses were designed primarily for trimming drop-forgings, the line including presses suitable for trimming drop-forgings up to the maximum size within the capacity of any drop-hammer built. In addition to this purpose, the presses are also suitable for general sheet-metal blanking and forming operations.

The main frame of the press is designed along heavy lines, and is a one-piece solid semi-steel casting with the legs cast integral. A front view of the machine showing the auxiliary shears on the left-hand side is illustrated in Fig. 1, while Fig. 2 shows a sectional view of the clutch referred to in the foregoing. In the latter illustration, it will be seen that the jaws of clutch member *B*, which is slidably mounted on a square portion of the shaft, are engaged with and disengaged from the jaws of the clutch plate *C* attached to the driving gear *D*, through the movement of roller *A* in the cam groove of clutch *B* and by the rotation

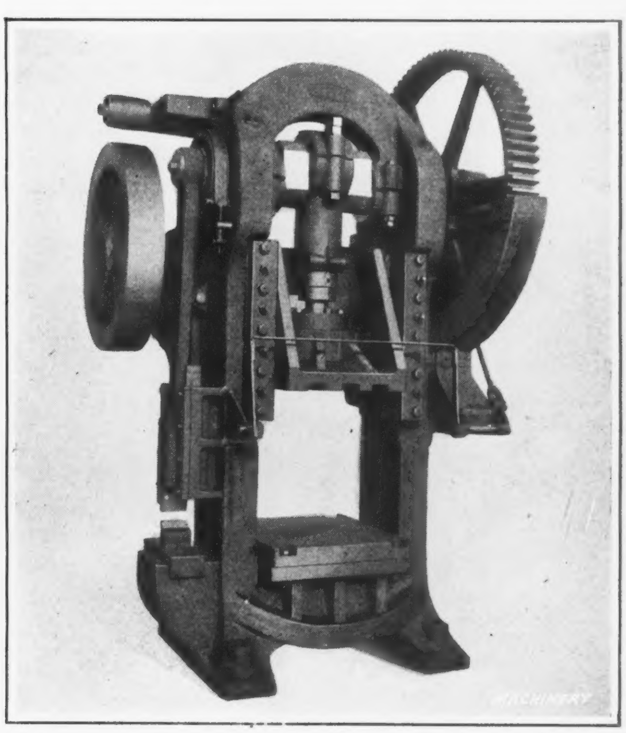


Fig. 1. Trimming Press which is Typical of a Line built by the Massillon Foundry & Machine Co.

of this clutch member. Roller *A* is mounted on a stud screwed into the clutch case, and after being adjusted to extend the desired amount into the clutch, it is held permanently in place by means of a locking nut.

In the operation of the press, when roller *A* is pulled past the highest point of the cam groove on clutch *B*, springs *E* force the clutch forward so that its jaws engage those of the plate on the driving gear and thus positively lock the driving shaft and gear together, permitting a revolution of the shaft to take place. In order to move roller *A*, the clutch case is given a portion of a revolution by lowering the tripping lever shown in Fig. 1 extending across the front of the machine. This lever is connected by means of a shaft to a rod attached to a lug on the clutch case, and so pulls the latter forward. After the driving shaft has made a revolution, clutch *B* is returned to its original position by the action of the cam groove against the roller. The jaws on both members *B* and *C* are made of hardened steel and so designed that they may be removed and replaced in case of wear.

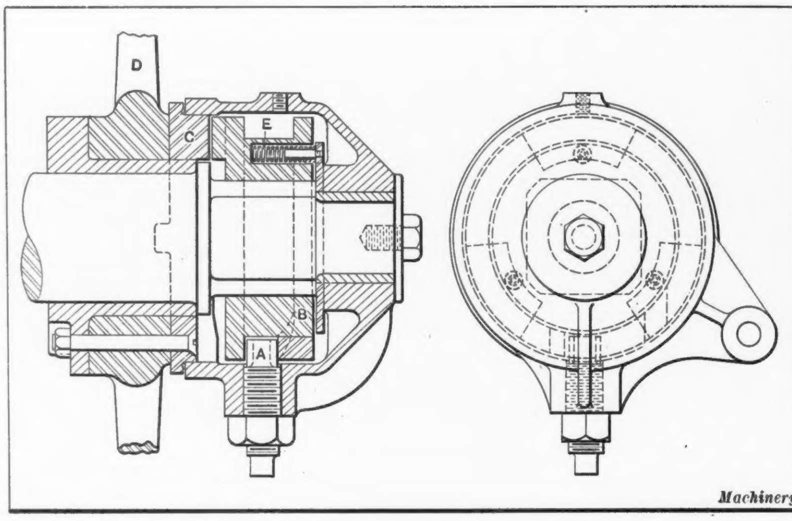
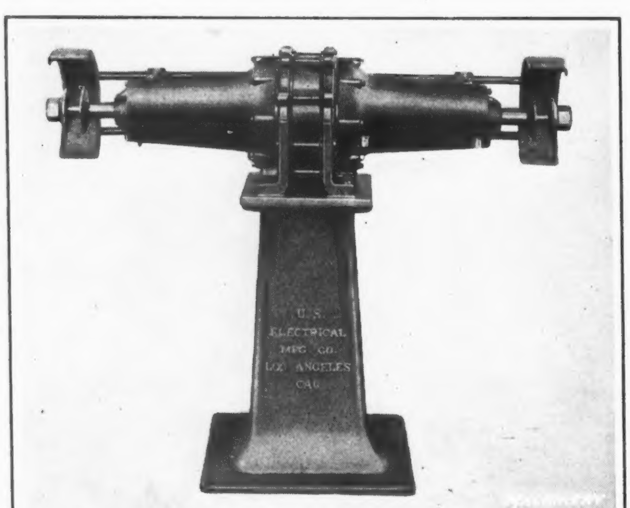


Fig. 2. Sectional View of Clutch mounted on Driving Shaft of the Trimming Press

In instances where the ordinary type of clutch fails to operate or repeats, the trouble is usually due to the failure of the clutch pin to function. Inasmuch as in the clutch described the pin is always in the cam groove, the clutch cannot fail to operate. The clutch mechanism is entirely enclosed by the clutch case and runs in a bath of oil. In addition to operation by the tripping lever as described, the clutch may also be operated by a foot-treadle. All main gears and pinions on the presses are made of open-hearth steel and have machined teeth.

U. S. ELECTRICAL GRINDING, BUFFING AND POLISHING MACHINE

The heavy-duty motor-driven grinding, buffing, and polishing machine shown in the accompanying illustration was originally designed for buffing pneumatic truck tires, but it has since proved suitable for use in plating plants, radiator and sheet metal works, etc. This machine is the product of the U. S. Electrical Mfg. Co., Central Ave. at Third, Los Angeles, Cal. It has an over-all shaft length of approximately 6 feet, so that two men can work on the machine at the same time without interfering with each other. Large ball bearings are used in the construction of the machine, sets of bearings being placed at the ends of the housing, while a set is also placed at the center of the machine to eliminate vibration of the rotor. The machine can be built in a number of different sizes for operation by two- or three-phase alternating current; but the most generally used size is said to be one having a five-horsepower motor running at 3600 revolutions per minute.



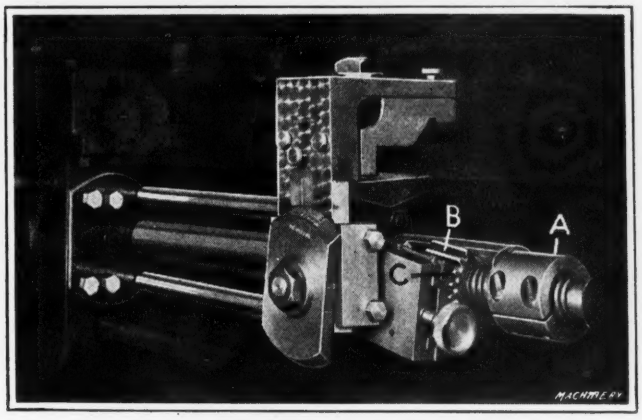
Motor-driven Grinding, Buffing, and Polishing Machine built by the U. S. Electrical Mfg. Co.

PRECISION THREAD LEAD VARIATOR

The Precision & Thread Grinder Mfg. Co., 1 S. 21st St., Philadelphia, Pa., has designed a thread lead variator for application on lathes to obtain any lead with the desired precision from an ordinary lead-screw. This variator also makes it possible to cut metric threads or threads of odd or unusual lead on any lathe. In addition to these advantages, a thread can be cut with a lead sufficiently over size to compensate for shrinkage in hardening the threaded part. The variator is applied at the right-hand end of the lead-screw which is seldom in contact with the carriage half-nuts, and, therefore, is rarely worn. By placing the variator on this section of the lead-screw, its application often eliminates the necessity of providing a new lead-screw when the one on the machine becomes worn on the section receiving severe usage.

With this variator the forward movements of the carriage are controlled by nut *A*, which is placed on the lead-screw and connected to the carriage by means of long rods, and attaching members. A gear segment *B* is dovetailed to the variating nut in such a manner that when the gear segment is rotated a portion of a revolution around the lead-screw, the variating nut is rotated a corresponding amount. However, the gear segment can also be swiveled to bring its teeth at an angle with the horizontal center line of the lead-screw, but this movement has no effect on the variating nut. Rotary movements of the gear segment are governed by its longitudinal movement past rack *C* which can also be inclined to bring its teeth at an angle with a horizontal plane. In cutting a thread, the amount that rack *C* should be inclined depends upon the accuracy with which a thread can be cut when the rack and gear teeth are in a horizontal position.

From the foregoing description it will be apparent that a forward movement of the carriage is caused by nut *A* as the latter advances due to the rotation of the lead-screw. The movement of the carriage, however, is slightly accelerated or retarded for the purpose of compensating for any error in the lead-screw, by the action of gear segment *B* as it advances along rack *C*. It will be seen that rack *C* is indirectly supported from the lathe bed. A graduated scale is provided to furnish readings of the angular setting of the rack. It will, of course, be understood that the half-nuts of the carriage are disengaged at the time the variator is being used.

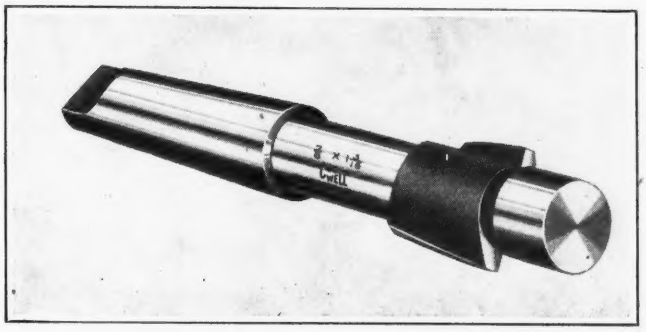


Lathe Attachment developed by the Precision & Thread Grinder Mfg. Co., to compensate for Lead-screw Errors

An interesting feature of the device is that the variating nut is not employed to return the carriage to its starting position, the latter movement being accomplished by means of a special return nut. This arrangement tends to preserve the accuracy of the variating nut and the lead-screw at the right end. A cover is furnished for protecting the lead-screw from abrasive dust when performing thread-grinding operations on the lathe. This precision thread lead variator is manufactured in two models, one of which is suitable for lathes from 9- to 12-inch swing, and the other for machines from 13- to 20-inch swing.

BICKFORD-SWITZER COUNTERBORE

A counterbore with two cutting lips, known under the trade name of "Cutwell" has been designed by the Bickford-Switzer Co., 50 Norwood St., Greenfield, Mass., for performing counterboring operations on a production basis. This tool is shown in the accompanying illustration. It is claimed that on account of the ample clearances provided on the cutting lips and the design of the latter, work can be accomplished with expedition and chattering of the tool is eliminated. The cutting action of the counterbore is similar to that of a drill, and the chips produced are like those obtained when drilling. There is plenty of room to permit convenient resharpening of the cutting lips, and either lip is sufficiently strong to perform an operation if the resharpening has been carelessly done.



Two-lipped Counterbore which is a Product of the Bickford-Switzer Co.

LUMSDEN OSCILLATING SURFACE GRINDER

The Lumsden No. 86 oscillating surface grinder which is shown in Figs. 1 and 2 has been placed on the market by Alfred Herbert, Ltd., 54 Dey St., New York City. The particular field of this machine is locomotive, shipbuilding and general engineering shops where plane surfaces are ground on such products as steel railway buffers, journal boxes, journal box covers, etc. The capacity of the machine is for surfaces up to about 24 by 10 inches. The new machine is built on the same principle as the Lumsden oscillating tool grinder described in the August, 1919, number of MACHINERY, the grinding wheel head being mounted on a swinging arm having two trunnions supported by bearings on the bed. The arm is oscillated about the center of these bearings, the movement being obtained by a connecting-rod operated by a crank on a three-speed gear-box mounted on the bed. By adjusting the throw of the crank, the stroke of the oscillating arm measured at the edge of the wheel and in a vertical line with its center, can be varied from zero to a maximum of 24 inches.

The machine is provided with a 16-inch cup-wheel having eight segments, the wheel being mounted on a ball-bearing spindle carried in a ram having an adjustment parallel with the axis of oscillation of the swinging arm. This adjustment is employed for feeding the wheel to the work, is controlled by a handwheel on the gear-box, and can be operated when the arm is in motion. The wheel segments are 6 inches long and can be used down to a length of 1½ inches. The spindle is driven by a belt from a self-contained countershaft located at the center of oscillation of the swinging arm and supported by bearings in the trunnions, and one on the bed. T-slots are provided on the table, and the latter has a cast-iron trough. Ample supply of water is insured by a pump driven from the countershaft.

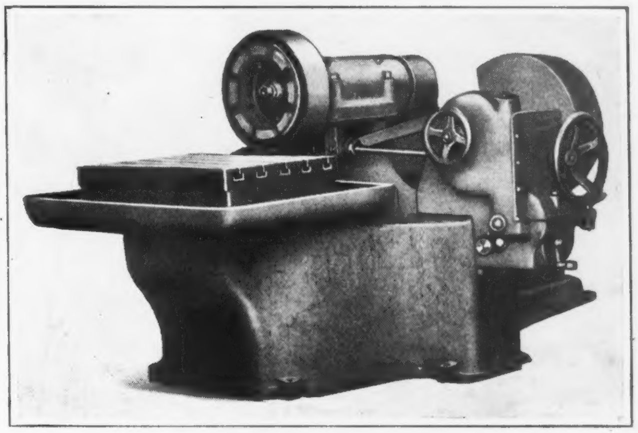


Fig. 1. Front View of Lumsden Oscillating Surface Grinder introduced by Alfred Herbert, Ltd.

The number of oscillatory movements of the wheel-head per minute, suitable for strokes of different lengths are as follows: 43 strokes up to 8 inches in length; 21½ strokes from 8 to 16 inches in length; and 10 strokes from 16 to 24 inches in length. The working surface of the table is 36 by 25½ inches; hand feed of wheel, 3 inches; wheel-spindle speed, 1088 R.P.M.; horsepower required to drive machine, 20; and net weight of machine approximately 8100 pounds.

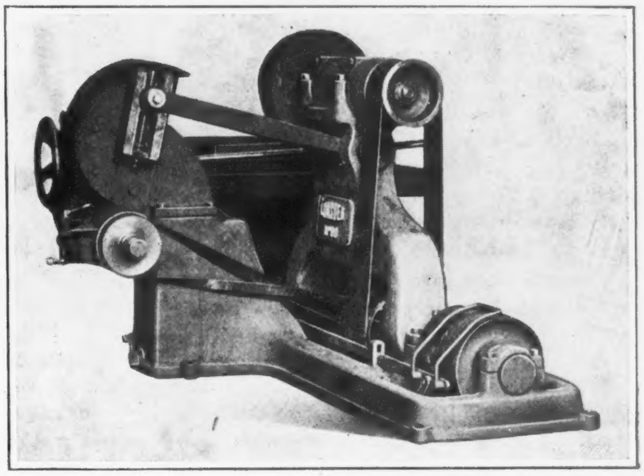


Fig. 2. Rear View of Surface Grinder showing Crank and Connecting-rod for oscillating the Wheel-head

BICKFORD-SWITZER DRILL GRINDER

A drill grinding machine constructed in such a manner that both lips of the drill are brought consecutively in contact with the grinding wheel so that the sharpening of both is completed at the same time is here illustrated. This machine is a product of the Bickford-Switzer Co., 50 Norwood St., Greenfield, Mass., and has a capacity for grinding drills ranging from 1/8 to 3/4 inch in diameter. In grinding a drill, the latter is held in a chuck, and by revolving a crank, it is given a combined rotative, eccentric, and swinging motion, which not only causes the drill to be ground to the correct radial and lip clearance, but also permits the lips to be brought consecutively in contact with the grinding wheel, as previously mentioned. The result of this arrangement is that the drill is ground true with its axis.

Drill Grinder made by the Bickford-Switzer Co.

An advantage of the machine is that its operation does not require a skilled worker, as anyone having sufficient intelligence to read an ordinary scale can grind a drill accurately, a scale being employed to set the machine for grinding drills of different sizes. The drill is located absolutely centrally on the machine by supporting the back end by a cup center, and the front end by two special jaws which locate and grip the working part of the drill. The operation of the machine is simple, it being only necessary to set several levers and revolve a crank. It is claimed that when a drill is sharpened on the machine it will be commercially perfect and will not drill a hole more than 0.002 inch larger than its nominal size, thus making it possible in some instances to omit a reaming operation on work. Only about a minute is required to make all adjustments necessary for grinding a drill (even if the drill is of a different size from the last one) and for the grinding operation.

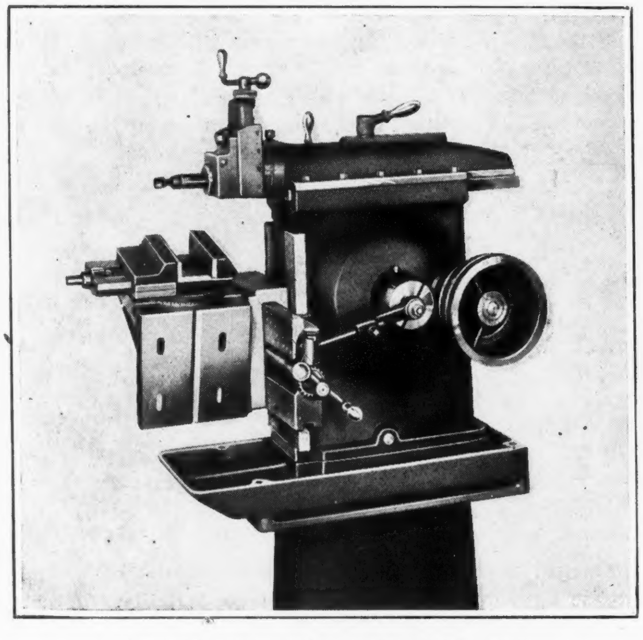
It has been repeatedly demonstrated that if a drill is slightly beveled at the outer corners of the cutting lips, its usefulness is greatly increased. On the machine described, these corners are rounded, the operation being performed during the sharpening of the lips. The machine is driven from a lamp socket, and can be arranged for either alternating or direct current.

PLETZ 9-INCH SHAPER

A 9-inch shaper has recently been placed on the market by Carl Pletz & Sons, 3116 Spring Grove Ave., Cincinnati, Ohio. This machine has been designed to meet the demand for a sturdy and accurate tool having the necessary range and capacity for handling the general run of shaper work found in a tool-room, die shop, and experimental shop. It is sturdy enough so that it has also a field as a manufacturing tool on small work. It is especially adapted for small keyseating, where it will enable rapid production to be obtained.

The ram is constructed with wide and long bearing surfaces, and can be set to any length of stroke within its range. A graduated scale is provided on the rocker arm, which shows the length of the stroke at a glance. The bearings are fitted with felt oilers, insuring proper lubrication. The column is rigid, with a heavy wall of metal all around, and with flanges at the bottom, where it is bolted to the base. The ram-way is fitted with a taper gib, which is adjustable for wear.

The cross-rail slides on a wide bearing on the column, is securely gibbed, and has provision for taking up wear. The swivel table is of box section, bolted to the saddle with four bolts, and may be set at any angle. It is graduated in degrees, the graduations being large enough to permit setting to a fraction of a degree. A dowel-pin locates the table at zero. The automatic feed will operate in either direction and can be adjusted to suit.



Nine-inch Shaper made by Carl Pletz & Sons

The drive is by a cone pulley mounted on a sleeve, thereby removing the belt pull from the pinion-shaft. The main bearing is bronze-bushed and provided with an oil reservoir. The vise is of heavy construction with hardened steel jaws; it has a graduated base, and can be swiveled to any angle. The standard equipment consists of a universal table, two wrenches, and countershaft. The pedestal is furnished with the machine at an extra charge.

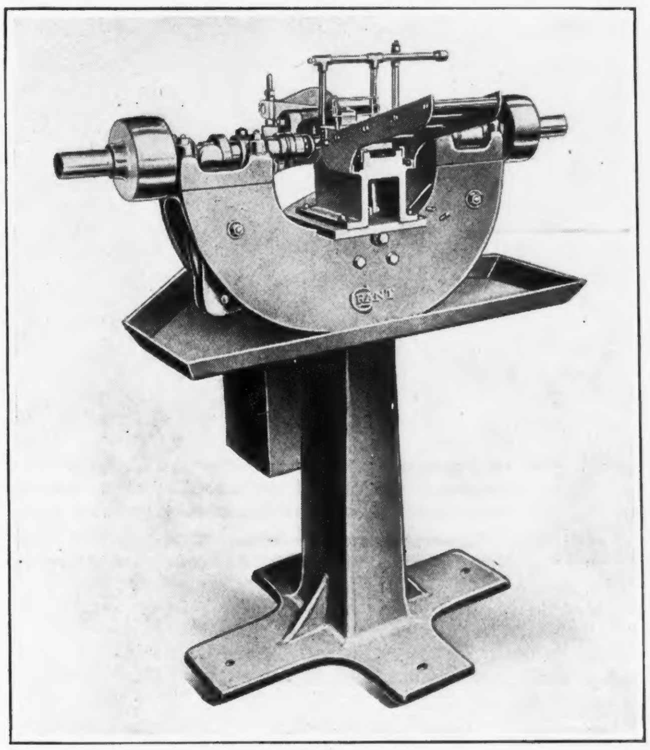
The most important specifications for the machine are: Length of stroke, 9½ inches; strokes per minute, 25 to 100;

cross-feed of table, 10½ inches; vertical feed of table, 10 inches; vertical feed of tool-head, 3 inches; table surface top, 8 by 8 inches; maximum distance from bottom of ram to table, 10¼ inches; countershaft speed, 280 revolutions per minute; weight, bench type, 535 pounds; weight, bench type, boxed for export, 635 pounds; weight with pedestal, 735 pounds; weight with pedestal, boxed for export, 850 pounds; floor space, 26 by 30 inches.

GRANT AUTOMATIC CHAMFERING MACHINE

A double-spindle automatic chamfering machine built by the Grant Mfg. & Machine Co., N. W. Station, Bridgeport, Conn., was described in detail in the September number of MACHINERY. The accompanying illustration shows another machine of the same type but of an improved design. It is intended for performing a chamfering operation on both ends of parts. The work is placed in the inclined hopper or magazine from which it is fed by a slide mechanism to the proper machining position where it is clamped and rigidly held while the chamfering operations are being performed. The finished pieces are then automatically ejected. The hopper may be furnished to suit various kinds of work having circular, square, hexagonal, or other irregular shapes, provided an operation is to be performed on both ends.

The spindle bushings have a lateral adjustment of approximately 2 inches. The spindles are fed to the work by fulcrum levers at each end of the machine which are operated by face cams. The driving pulley is placed at the rear of the machine and is provided with a roller friction clutch.

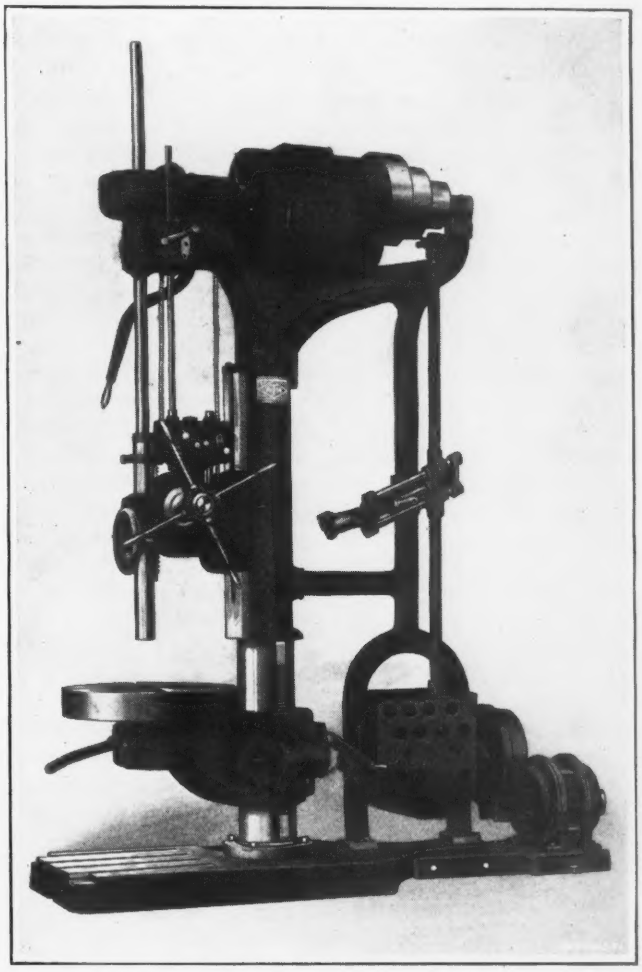


No. 183 Automatic Double-spindle Chamfering Machine built by the Grant Mfg. & Machine Co.

The pulley shaft extends to the front of the machine and by means of worm-gearing, drives the camshaft which operates the fulcrum levers. Another set of worm-gearing operates the feeding and clamping devices. A gear-driven pump feeds cutting lubricant to the tools.

WEIGEL VERTICAL DRILLING MACHINE

In the October, 1917, number of MACHINERY, a detailed description was given of a 25-inch vertical drilling machine built by the Weigel Machine Tool Co., Peru, Ind. The accompanying illustration shows this machine with an improved type of mechanical belt shifter and a geared motor drive. The driving gear of the lower cone pulley shaft is driven from the bottom so that the motor is brought close to the base with a view to eliminating vibration. The cone pulley is guarded by a steel cover, and when a tight and loose pulley drive is furnished, the cover is adjustable to permit the belt to run at any angle.



Vertical Drilling Machine manufactured by the Weigel Machine Tool Co., equipped with an Improved Belt Shifter

The mechanical belt shifter is readily operated from the side of the machine without the necessity of the operator touching the belt. When a tight and loose pulley drive is furnished, the belt need not be shifted except when starting the machine. The spindle of the machine may be started stopped, and thrown into high or low speed by a single lever at the front of the machine. The friction back-gears are of an improved type having a double grip friction to make them as nearly positive as possible. All gearing is entirely covered to bring the machine in compliance with state laws.

The machine can be furnished with an improved friction tapping attachment built as an integral unit. It is mounted directly on the spindle, and has a reverse motion of 2 to 1; when used in connection with the back-gears, it has a reverse of 12 to 1. Round or square tables with oil channels, or a compound table with an adjustable jack to insure rigidity, can be supplied. A cast oil-pan base having a depth of 8 inches to give ample tank capacity can also be provided.

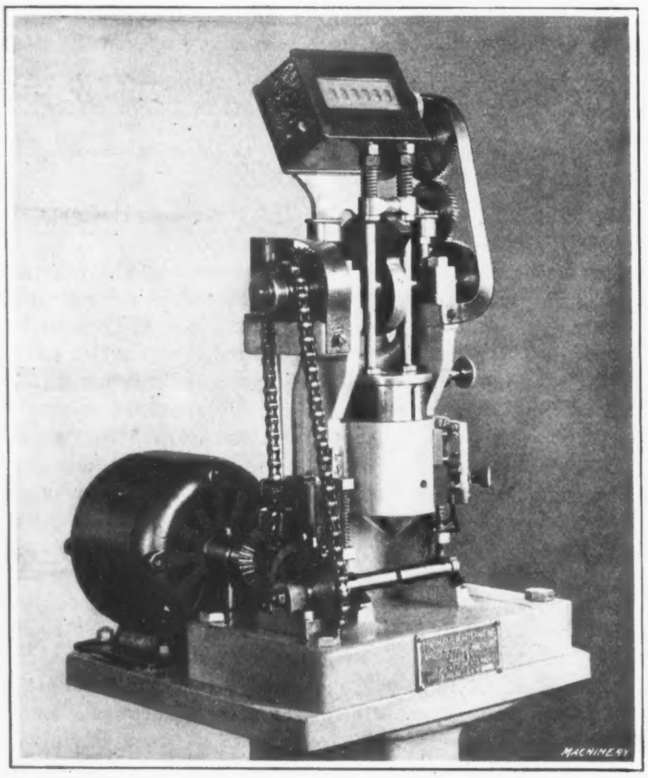
PITTSBURG IMPACT TESTING MACHINE

In the selection of iron, steel, and alloys for parts of machine tools, automobiles, airplanes, etc., which will be subjected to continuous shocks and stresses, the material should

be tested in such a way as to closely conform to actual working conditions. For the purpose of testing the elasticity and resistance to shock of such materials, the Pittsburg Instrument & Machine Co., 40 Water St., Pittsburg, Pa., has developed the continuous and alternating impact testing machine here illustrated. This machine subjects the material to a series of fatigue and impact fatigue tests in such a way that the test piece is not destroyed by one blow. The number of blows required to break a test piece are recorded on the counting device mounted at the top of the machine. Different kinds of steel vary greatly in the number of blows required to establish the breaking point, and for this reason the principle upon which the machine is based is a practical one for determining the homogeneity of the metal and its resistance to shock.

The piece to be tested should be turned to a diameter of ½ inch and have a round or sharp notch. When placed on the machine, the test piece rests on two bearings so that the ram is central with the notch. A feeding attachment revolves the specimen one-half a revolution for alternating tests, or by means of a special attachment, one twenty-fifth of a revolution for continuous tests. Alternating tests are employed for materials used in making eccentric shafts, automobile and railway axles, airplane parts, and parts used under similar conditions of service, while continuous tests are especially useful on building material.

The machine is set to deliver from 85 to 100 blows per minute. The ram is of a given weight, is raised by a cam driven from an electric motor, and then released to fall on the test piece. The ram is supported by two sliding rods connected by a roller cross-piece against which the lifting cam operates. The main body casting is provided with a vertical slide for guiding the ram during the up and down movements of the latter. The ram has a hardened anvil which strikes the center of the test piece, this piece being prevented from moving sidewise by a special arrangement. As soon as the test piece breaks, the machine is stopped,

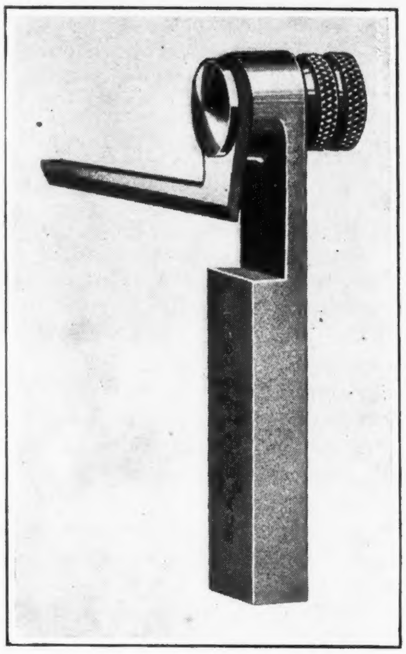


Impact Testing Machine built by the Pittsburg Instrument & Machine Co.

because the ram drops beyond a certain point and shuts off the electric current. The number of blows required to break a test piece, of course, depends upon the quality of the material being tested, its structure and the heat-treatment that it has received.

SCALBOM DIE SQUARE AND BEVEL GAGE

The die square and bevel gage shown in the accompanying illustration is essentially a diemaker's tool, but it will also be found useful by toolmakers and machinists. It is made by the Scalbom Mfg. Co., 11 S. Desplaines St., Chicago, Ill. The tool consists of a body, a thin blade which can be swiveled to any desired angle relative to the axis of the body, and an arrangement for clamping the blade after it has been set. This construction renders the tool suitable for laying out angular lines on a surface at right angles to the one against which the body is held. The tool also will be found convenient for ascertaining the taper of a hole. When the blade is inserted in a hole, the recess in the body permits a view of the blade edge for its entire length. Blades of different thicknesses can be furnished. All parts are made of steel, and are hardened and ground.



Die Square and Bevel Gage made by the Scalbom Mfg. Co.

NEW MACHINERY AND TOOLS NOTES

Crane: New Jersey Foundry & Machine Co., 90 West St., New York City. A hand type traveling crane developed to facilitate handling molding machine and pouring work in foundries or work of a similar nature.

Torch-burner: Clayton & Lambert Mfg. Co., 1371 Beaubien St., Detroit, Mich. A double needle-point burner, designed to burn low-grade gasoline or kerosene or a mixture of both. This burner is supplied with torches made in quart, pint, and two-quart capacities.

Box-tool for Screw Machines: Cruban Machine & Steel Corporation, 63 Duane St., New York City. A box-tool for use on screw machines, known as the "Micro," which is provided with a 1-inch shank and is adapted for handling bar stock up to 1 inch in diameter. Micrometer adjustment, reading to thousandths of an inch, is provided for adjusting the tool. The work can be guided by V-guides or bushings.

Combination Boring Machine: K. R. Wilson, 10-16 Lock St., Buffalo, N. Y. A machine intended for work on automotive engine cylinder blocks and crankcases. It serves as a motor bench for holding the motor while assembling, grinding valves, or babbitting bearings, and is adapted for boring, reaming, and running-in main bearings. A belt-driven head and work-holding carriage are provided for boring cylinders and similar work.

Industrial Tractor: Reliance Trailer & Truck Co., Inc., 30 Eighth St., San Francisco, Cal. A gasoline motor-driven industrial tractor of practically all-steel construction which can be used for either pushing or towing. The truck is capable of carrying two tons. The over-all length is 6 feet 6 inches, and the over-all width 50 inches. The tractor will turn in a circle 12 feet in diameter, and will tow a 5- to 6-ton load; heavier loads can be drawn by placing ballast under the box seat.

Disk Sander: Syracuse Sander Mfg. Co., Inc., Syracuse, N. Y. A motor-driven portable disk sander especially adapted for use in pattern shops and woodworking shops. The machine is also adapted for handling light work in a machine shop, such as grinding small metal parts, especially those of brass and aluminum. Garnet paper disks are used for wood work and emery cloth disks for metal work. The table can be adjusted to 45 degrees below the horizontal, and 15 degrees above.

Pocket Calculator: Small, Small & Co., Waltham, Mass. A pocket calculator intended primarily for performing such calculations as are ordinarily performed on a slide-rule. It consists essentially of a 6-inch logarithmic slide-rule with the scales bent into a circle so as to form a compact instrument. The calculator is made in two models; the No. 1 has the ordinary slide-rule scales, while the No. 2, which is intended for architects and structural engineers, has scales for determining the strength of steel and wooden beams.

Die-heads: Eastern Machine Screw Corporation, 23-43 Barclay St., New Haven, Conn. Several new sizes of the H. & G. line of self-opening die-heads. The new sizes include 2½- and 3-inch Style A die-heads, with capacities of 1½ to 2½ inches, and of 2 to 3 inches, respectively, which are for use on automatic screw machines. The new products also include 2-, 2½-, and 3-inch Style C die-heads having a total range of from 1 to 3 inches, which are intended for use on turret lathes where the die-head does not rotate. Another die-head intended for use on Brown & Sharpe machines is made in a 7/16-inch size.

PERSONALS

Eugene F. Fagan, formerly general superintendent of the Federal Electric Co. and subsidiaries, Chicago, Ill., has become associated with the Lyon Metallic Mfg. Co. of Aurora, Ill., in the capacity of purchasing agent.

Donald S. Michelson, who became general manager of the Globe Machine & Stamping Co., Cleveland, Ohio, in September, 1920, was elected president of the company at the annual meeting held on February 1.

Charles H. Richards, formerly with the Remington Arms, Inc., has been appointed general manager of the Warren F. Fraser Co., of Westboro, Mass., manufacturer of semi-automatic and full automatic universal and plain grinders.

Joseph L. Holstein, formerly salesman for the National Tool Co., Cleveland, Ohio, has joined the selling force of the Shields Cutter Co., Cleveland, Ohio, and will cover the northern sections of the states of Indiana, Ohio, and New York.

Dyer Smith, at one time assistant editor of Machinery, has associated himself with S. Mortimer Ward, Jr., and Gorham Crosby, under the firm name of Ward, Crosby & Smith, to engage in the practice of patent and trademark law, with offices at 233 Broadway, New York City.

S. T. Thompson, purchasing agent of the Duplex Engine Governor Co., Inc., Brooklyn, N. Y., has been made director of sales of the company. The vacancy left by Mr. Thompson has been filled by C. F. Guttzeit, who was formerly assistant purchasing agent. The Duplex Engine Governor Co., Inc., manufactures the "Duplex" and "Simplex" governors for internal combustion engines.

George C. Winchel, for several years associated with various Cleveland and Akron industries as special machine designer and engineer, and for two years experimental engineer for the B. F. Goodrich Co., has opened offices at 304 Everett Bldg., Akron, Ohio, as a designing engineer of special, automatic, and production machinery, including general plant lay-out and design.

Robert M. Eames has been appointed general sales manager of the Bryant Electric Co., Bridgeport, Conn., to fill the vacancy made by the resignation of Frank V. Burton. Mr. Eames has been active in the sales organization of the company for fifteen years, and for several years has been its export manager. He is thoroughly familiar with the sales policy as well as with the complete line.

Robert M. Carter has joined the Kempsmith Mfg. Co., Milwaukee, Wis., as manager of sales. Mr. Carter has had a wide experience in the machine tool line, having been connected with the Gisholt Machine Co. of Madison, Wis., and more recently with the Giddings & Lewis Machine Tool Co., Fond du Lac, Wis., as manager of sales. He succeeds Peter Lowe, who has resigned due to illness.

George Lahusen, Jr., formerly of the E. L. Essley Machinery Co., Chicago, Ill., has become associated with the Badger-Packard Machinery Co. of Milwaukee, Wis., representing the company in the southern Wisconsin territory. Mr. Lahusen has had extensive experience in the machine tool industry at Cincinnati, and for several years has been traveling regularly through the southern Wisconsin territory for the E. L. Essley Machinery Co.

George J. Blanton, who for the last four years has been connected with the engineering sales department of Chain Belt Co., Milwaukee, has been made New York district manager, with headquarters at 50 Church St., New York City. Before joining the company in 1917, he was associated with the General Electric Co. for eight years, three years of which were spent in Schenectady, N. Y., and the other five in the Milwaukee office. Mr. Blanton has had a wide experience in engineering sales work and has comprehensive practical knowledge of the chain industry.

Lawrence Wilkerson Wallace was elected secretary of the American Engineering Council at the meeting of the executive board in Syracuse, N. Y., on February 14, succeeding L. P. Alford of New York, who has been acting secretary since the formation of the council in Washington on November 19, 1920. Mr. Wallace was born in Austin, Texas, August 5, 1881. He was graduated from the Agricultural and Mechanical College of Texas in 1903 with the degree of B.S. in Mechanical Engineering. In 1912 he received the degree of M.E. from Purdue University. From 1903 to 1906 he served a special apprenticeship with the Santa Fé Railway Co., and was a member of the Purdue faculty during 1906-1907 becoming head of the department of railway and industrial management. Mr. Wallace also brings to the secretaryship of the council the experience of a manufacturing executive. He was formerly assistant general manager in charge of production of the Diamond Chain & Mfg. Co. of Indianapolis, and more recently was director of the Red Cross Institute for the Blind in Baltimore, which provided vocational training to the blinded men of the military forces.

OBITUARIES

Melville P. Hayward, for some time assistant purchasing agent at the plant of the American Bosch Magneto Corporation, Springfield, Mass., died in Springfield after a short illness from pneumonia, on January 4.

George R. Randolph, Pittsburg sales representative of the Warner & Swasey Co., Cleveland, Ohio, died February 3, aged twenty-six. Mr. Randolph had been in the Pittsburg district only about seven months, but had been associated with the Warner & Swasey Co. for six years.

* * *

PROPOSED WORK FOR FEDERATED AMERICAN ENGINEERING SOCIETIES

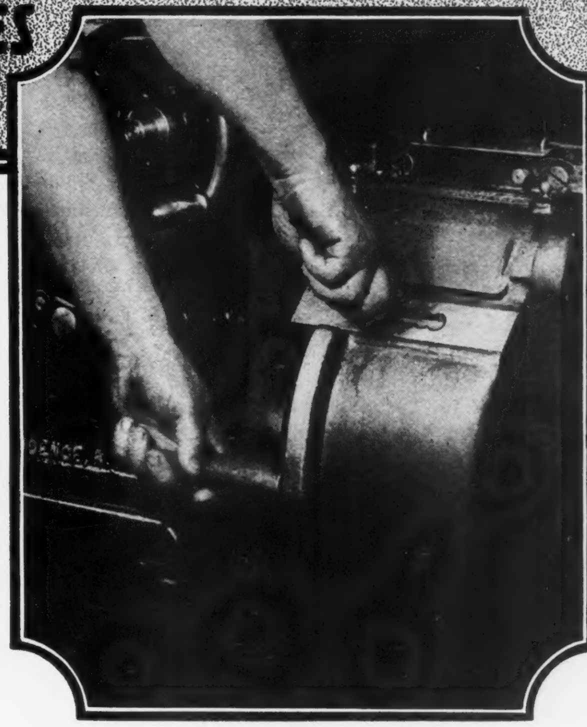
The Federated American Engineering Societies is now actively at work furthering the purposes for which it was formed. The committee on plan and scope made a report and proposed that subjects for consideration for the American Engineering Council may be initiated by either the board itself or by outside sources. The committee also proposed the following topics as coming within the present scope of the work of the Federated Engineering Societies: (1) To serve the public interest by investigation and advice to all public governmental and voluntary bodies dealing with national economic problems; (2) department of public works; (3) conservation of national resources; (4) cooperation with other national organizations—technical, industrial, and commercial; (5) technical education; (6) transportation, particularly highways; (7) advice to state, regional, and local societies; (8) national bureau of economic research; (9) public fire protection; (10) patents; (11) national board of jurisdictional awards; (12) international affiliation of engineers; (13) state organization of local affiliations; (14) licensing professional engineers; (15) classification and compensation of engineers; and (16) engineering societies' service bureau.

* * *

CHINA ESTABLISHES TRADE SCHOOLS

A model trade school has been organized by the inauguration of a method of cooperation between the Chinese Government Normal School at Peking and the Peking University. China is coming to realize, as other nations have done, that industrial progress requires technical training, and that modern industries can be established only by the development of skill and knowledge. In 1918 a trade school was opened in Shanghai, and this school has proved so successful that arrangements have been made for the establishment of similar schools in other sections of the empire. The Shanghai school is said to be run on such thoroughly modern lines that it would be a credit to any American city. Many American educators have been active in the establishment of these Chinese industrial schools, and there is no doubt that it would greatly benefit American industries, especially in the machine-building fields, if the efforts being made to educate the Chinese along industrial lines were actively aided from the United States.

Plain Grinding Machines Service



Changing Table Feeds

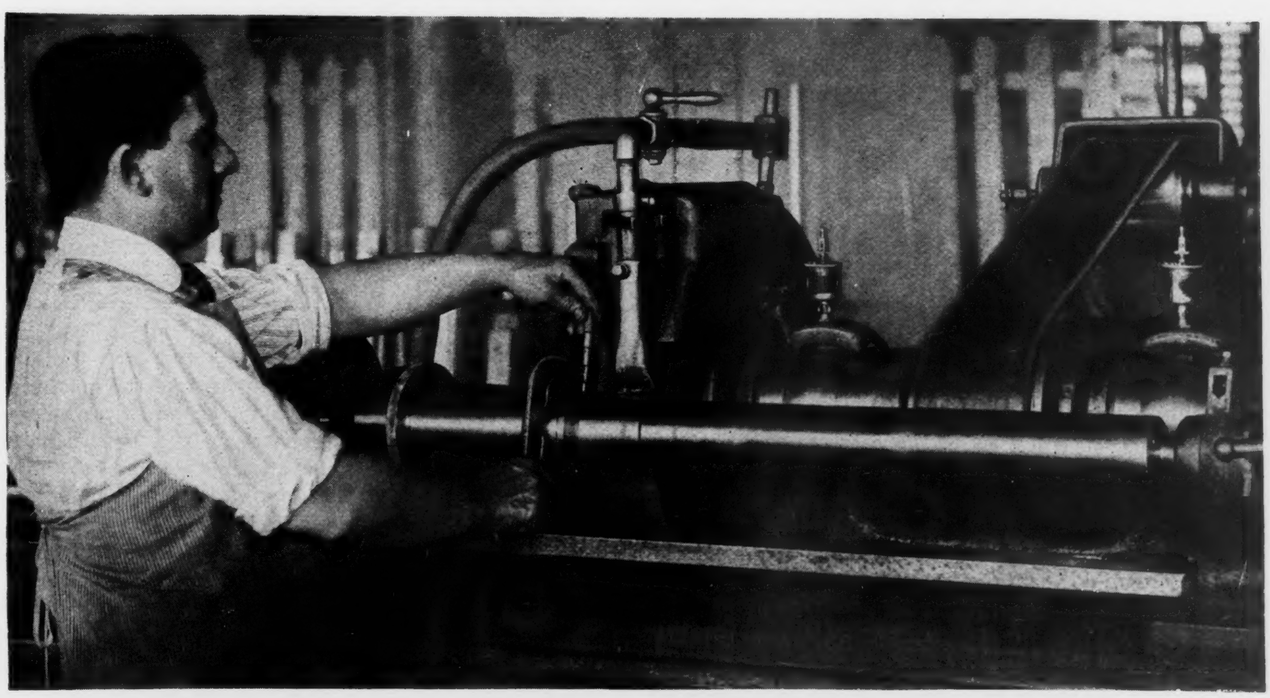
The grinding of the spindle shown in the illustrations is adequately taken care of by

BROWN & SHARPE

Plain Grinding Machines

The speed and accuracy with which the pieces are produced instantly appeal to both the operator and the production man. Work of large or small diameter, straight or taper grinding is all the same to the operator of one of these machines.

Send for Catalog 137, describing our complete line.



PROVIDENCE, R.I., U.S.A.

MACHINING STEERING ARMS ON DANIELS AUTOMATICS

To provide for the rapid performance of turning, facing, threading, drilling, boring, reaming, tapping, and other similar operations on parts that are to be made in sufficiently large quantities so that an investment in a fairly complex set of tools is fully justified by the economies that are made possible through their use, the McDonough Mfg. Co., 1500-1600 Galloway St., Eau Claire, Wis., has recently developed the Daniels vertical automatic chucking machine. In Figs. 1 and 2 this equipment is illustrated engaged upon the performance of a combination straight and taper turning and threading operation on two types of steering arms for use in motor cars built by the Olds Motor Works, in Lansing, Mich.

It will be seen that the two pieces which are handled on these machines are of the same design, in so far as the end to be machined is concerned. This consists of a tapered bearing with a straight threaded fit at the end of it. The portion of the work below this machined section differs in the two types of arms which will be seen hanging in two groups on the oil-pan of the machine. Each type of arm is held for machining by a special vise of suitable design, which is furnished with a set of vertical jaws that hold the end to be machined in place under the spindle, while the other end of the work is gripped between a pair of auxiliary jaws to secure it in a permanent position.

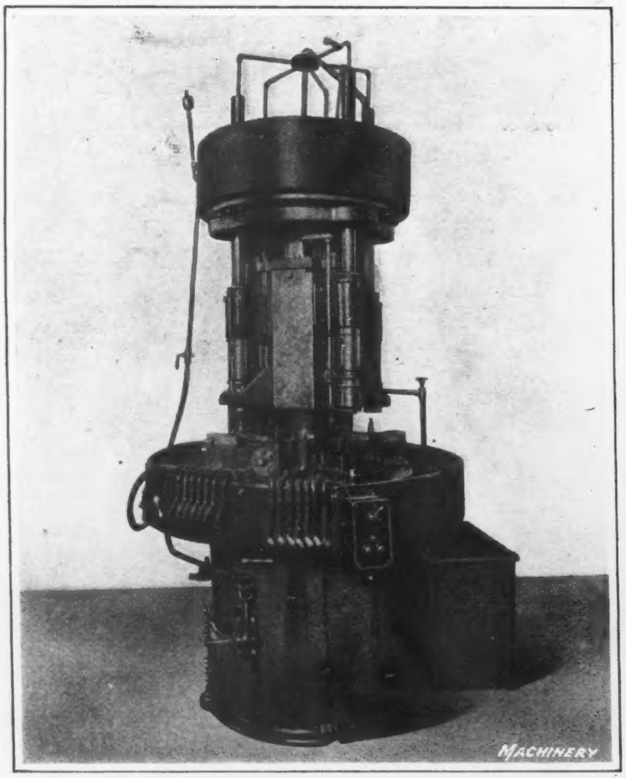


Fig. 1. Daniels Vertical Automatic Chucking Machine built by the McDonough Mfg. Co. and equipped for machining Two Types of Steering Arms

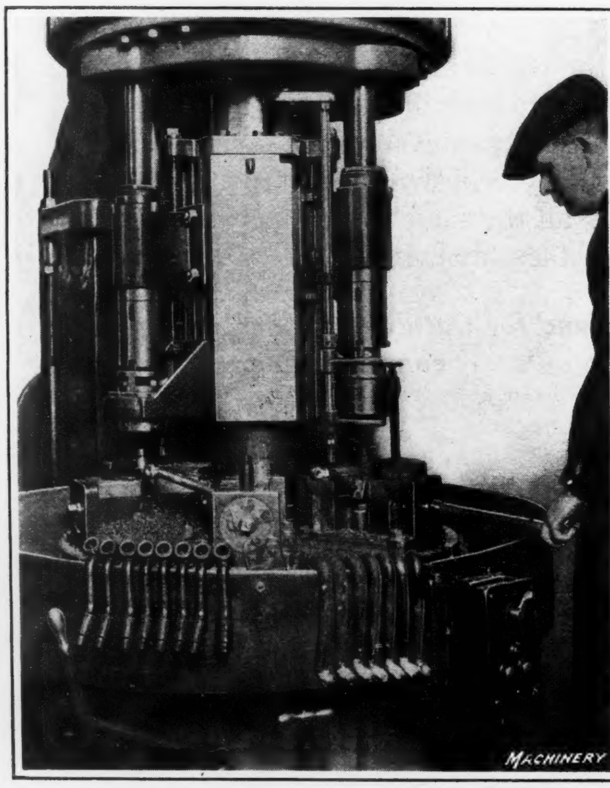


Fig. 2. Close-up View of the Daniels Vertical Automatic Chucking Machine showing more clearly the Arrangement of the Tools and Fixtures

On the Daniels vertical automatic chucking machine, there are five spindles by which a sequence of cutting tools is carried. Distributed around the table, there are six stations, five of which provide for holding the work beneath the spindles, so that five forgings may be simultaneously machined; and while this work is in progress, the operator's time is occupied in removing a finished piece and setting up a fresh forging at the sixth or so-called "loading" station. It will be evident that this machine works on the progressive principle, so that every time the table is indexed, each piece of work is brought into place under a tool which performs an operation that brings it one step closer to the finished condition. Such being the case, it will be apparent that one finished piece is obtained for each table movement.

In machining these steering arms, the sequence of operations performed is as follows: Station No. 1, load; station No. 2, rough-turn the thread fit and half way down the taper; station No. 3, rough-turn the remainder of the taper; station No. 4, finish-turn the thread fit; station No. 5, finish-turn the taper; station No. 6, cut the thread. It will be apparent that suitable box-tools are used on four of the spindles to provide for handling the rough- and finish-turning operations, while a self-opening die-head made by the Murchey Machine & Tool Co., of Detroit, Mich., is furnished on the fifth spindle to enable the thread to be cut on the work. Following the usual procedure, this die-head opens automatically after completing its operation, so that it may be withdrawn by simply raising the spindle without reversing the direction of rotation.

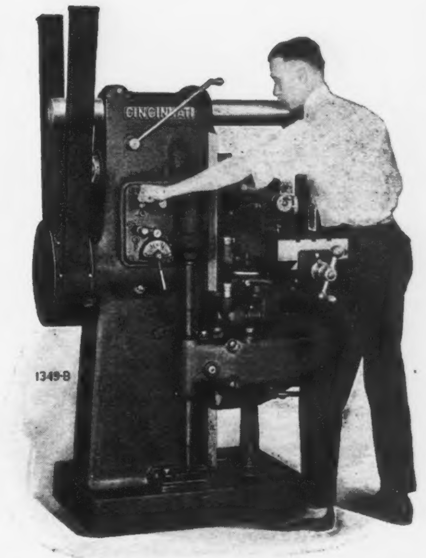
There are two of these Daniels vertical automatic chucking machines in operation in the Olds Motor Works, and mention has already been made of the fact that they are engaged in the machining of two different types of steering arms. Each machine is equipped with four fixtures for holding one type of arm and two fixtures for holding the other type, because there is a demand for twice as many pieces of one kind as there is of the other. Such a method of equipping the machines is satisfactory, owing to the fact that although the work is of two different kinds, the shape and size of the ends of the arms that have to be machined are identical. While operating on both of these, the rate of production is 120 pieces per hour per machine equaling with two machines and two men, the production previously obtained from twelve machines and twelve operators.

* * *

An effort is made in Brazil to develop both the coal mining and the steel industry of the country to a point where it may become of national importance, and to this end the Brazilian Congress is considering the payment of subsidies to the steel industry as well as to the coal mining companies for a period of three years.

Without Leaving His Position

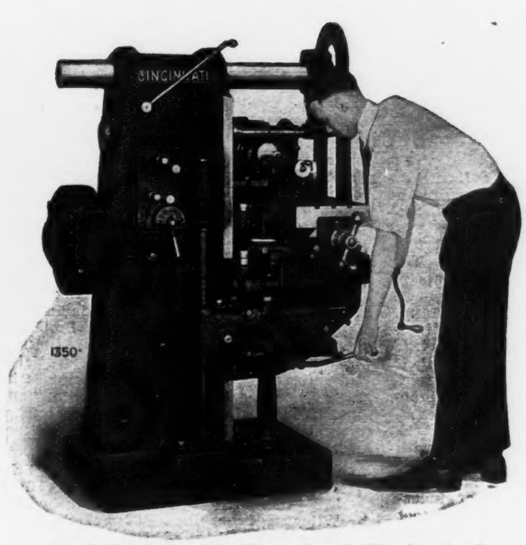
The operator can start the
machine—
Change the feeds—
Change the speeds—and
Stop the machine—
When working on



The operator can usually reach the speed change levers without leaving his position. The belt is guarded 6 feet above the floor. This meets the usual factory safety requirements.

Plain, Universal or Vertical

CINCINNATI
M-TYPE MILLERS



Feed changes are all made at the front of the machine from the operator's normal position.

They are handy, compact, durable machines with unusual strength and power for their size.

ASK US FOR COMPLETE DETAILS GIVEN IN THE 1920-M CATALOG

THE CINCINNATI MILLING MACHINE COMPANY

CINCINNATI, OHIO, U. S. A.

COMING EVENTS

March 10—Annual exhibit of the evening work of the students at Pratt Institute, held in the School of Science and Technology of the institute from 7:30 to 9:30 in the evening.

April 18-21—Convention of the National Metal Trades Association in New York City; headquarters, Hotel Astor. Secretary, Homer D. Sayre, Peoples Gas Bldg., Chicago, Ill.

April 27-29—Convention of the Society of Industrial Engineers in Milwaukee, Wis. Business Manager, George C. Dent, 327 S. La Salle St., Chicago, Ill.

May 4-7—Eighth convention of the National Foreign Trade Council in Cleveland, Ohio. Secretary, O. K. Davis, 1 Hanover Square, New York City.

May 16-18—Joint convention of the National Supply & Machinery Dealers' Association, the Southern Supply & Machinery Dealers' Association, and the American Supply & Machinery Manufacturers' Association in Atlantic City, N. J.; headquarters, Marlborough-Blenheim Hotel.

May 23-26—Spring meeting of the American Society of Mechanical Engineers in Chicago, Ill.; headquarters, Congress Hotel. Assistant Secretary (Meetings), C. E. Davies, 29 W. 39th St., New York City.

The March sectional meetings of the American Society of Mechanical Engineers are as follows: **March 4**—Metropolitan Section at the Robert Treat Hotel, Newark, N. J.; **March 10**—Tri-cities Section at the Rock Island Chamber of Commerce, Rock Island, Ill.; **March 14**—Waterbury Section at Waterbury, Conn.; **March 17**—Bridgeport Section in the Chamber of Commerce Rooms, Bridgeport, Conn.; **March 17**—Toledo Section at the plant of the Toledo Railways & Light Co., Toledo, Ohio; **March 22**—Atlanta Section at the Carnegie Library, Atlanta, Ga.; **March 22**—Baltimore Section at the Engineers' Club, Baltimore, Md.; **March 22**—Philadelphia Section at the Engineers' Club, Philadelphia, Pa.; **March 25**—Colorado Section at the Metropole Hotel, Denver, Colo.; **March 25**—Metropolitan Section in the Engineering Societies' Building, 29 W. 39th St., New York City.

NEW BOOKS AND PAMPHLETS

Human Engineering. By Richard H. Mulliner. 367 pages, 5 by 7 inches. Published by Mulliner Bros., Syracuse, N. Y. Price, $5.

The author presents in the present work what is termed a text-book for manufacturing and business engineers, designed, as stated in the preface, for the development of man and business. The book makes a special plea for idealism in business and engineering education, and in business life. It is largely made up of quotations from noted writers and from statesmen. The author, who is a member of the American Society of Mechanical Engineers and president of Mulliner Bros., consulting engineers, makes a comparison between the action of the mind and the properties of the electric current. The book is divided into fourteen chapters, as follows: Miracles of Nature; History of the Mind; The Brains and Nervous System; The Mind Generators; The Mind Degenerators; The Mind Faculties; The Individualistic Predominating Mind Faculties; Human Engineering; Direct Mind Engineers; Alternating Mind Engineers; Mind Cultivation; Mind Studies for Manufacturing and Business Engineers; Electrical Facts; and Incidences in the Formation of Human Society.

Smithing and Forging. By Joseph G. Horner. 222 pages, 5½ by 8½ inches. Published by Emmott & Co., Ltd., 65 King St., Manchester, England. Price, 8s. 6d., net.

This book deals with present-day methods of forging by hand and by machine. The subject matter is of wide scope, including hand methods, those associated with the use of dies under power hammers, and of squeezing machines, with the numerous appliances that are necessary for the performance of the various operations. In addition, attention is given to the methods of heating, covering such points as fuels, kinds of furnaces, temperature regulation, measurement of temperature, etc., the last chapter being devoted to the subject of heat-treatment. The text is illustrated with line drawings wherever they are needed to clarify the description. The book contains eleven chapters, and an idea of the contents will be gained from the following list of headings: The Shop and its Equipment; the Tools and Appliances; the Operations; Examples of Anvil Work; Examples of Stamped Work; the Forms of Dies; Stamping under the Steam Hammer; Drop-hammer Work; the Work of Forging Machines; Methods of Heating-furnaces; and Heat-treatment.

Water Power Engineering. By Frank F. Fergusson. 116 pages, 4 by 6½ inches. Published by Isaac Pitman & Sons, 2 W. 45th St., New York City. Price, $1.

This book, which is one of a series known as Pitman's Technical Primer Series, treats of the basic principles of water power engineering, describing types of water turbines, their applications and operation. Fundamental formulas relating to water power engineering are developed, and examples are included from practice. No claim is made for originality in the present work, but the aim has been to give a more concise and orderly presentation of the data than has hitherto been available for students. The book is elementary in its treatment, and covers the theory, selection, design, and operation of water turbines, with brief reference to their principal accessories. The material is divided into seven chapters headed as follows: Types of Turbines and their Applications; The Turbine Runner (Francis Type) and the Theory of its Design; Specific Speed—Conditions in the Turbine Runner—Formulas and Constants; Pelton Wheels; Water Velocities in Hydro-electric Plants; the Pipe Line, and Regulation of Speed and Pressure Rise.

Crain's Market Data Book and Directory of Class, Trade, and Technical Publications. 462 pages, 6 by 9 inches. Published by G. D. Crain, Jr., 417 S. Dearborn St., Chicago, Ill. Price, $5.

This is the first edition of this work, which comprises a market data book and a directory of publications in the United States and Canada. It is unique in that it forms a reference book for advertisers, containing basic information regarding each trade, industry, and profession, as well as a list of special publications devoted to each industry. The book is intended to give an idea of the characteristics, extent, and possibilities of markets in the different fields, as well as a knowledge of the specific mediums through which the buyers in the fields may be reached. The list of publications gives the circulation, subscription price, size of type page, advertising page rates, frequency of publication and closing dates, as well as agency or cash discount when allowed. There are two general indexes, the first being an index of classification of the trades and industries analyzed in the text pages, and the second an alphabetical list of all the publications about which information is presented. Canadian publications are indexed separately.

Labor Maintenance. By Daniel Bloomfield. 530 pages, 5½ by 8½ inches. Published by the Ronald Press Co., 20 Vesey St., New York City. Price, $5.

This book is intended to fill the need for a handbook of employes' service work. As the author is a consultant in employment management and industrial relations, his experience enables him to give definite suggestions along these lines. The book deals extensively with industrial housing plans, financial aids, and other welfare systems. The aim throughout has been to give as many practical examples of successful work as possible, so that employers, employment executives, and service workers will have at hand the experience of other concerns, combined with information and discussion as to the best practices. The organization and function of a service department are outlined, and the subject of training the workers is discussed, several training systems that have been in successful operation being described in this connection. The problem of Americanization is considered, and health, sanitation, recreation, and safety work receive attention. Such important subjects as housing, and financial aids, including mutual benefit associations, group insurance, and profit-sharing systems are adequately treated.

How to Keep Invention Records. By Harry A. Toulmin. 85 pages, 5½ by 8 inches. Published by D. Appleton & Co., 35 W. 32nd St., New York City. Price, $2.

This book emphasizes the grave necessity of keeping adequate records of inventions. The author's experience as a patent counsel points to the fact that when proof of the prior right of a party can be produced in readily available form, much litigation can be avoided. Where litigation cannot be avoided, thousands of dollars are lost annually by the failure of inventors and their assistants to keep proper records of their inventions, their development and reduction to practice, and early commercial history. This experience is unnecessary if records are kept of the essential steps and their dates in connection with inventions. It is the purpose of this book to show how such records can be kept. In the first part of the book, the general nature of industrial property and monopolies granted to protect it are discussed; this section covers patents, trademarks, labels, prints, copyrights, and foreign protection. The second chapter gives a series of a dozen forms for recording the dates and other necessary data relating to inventions, as well as instructions for making the entries. The final chapter treats of the methods of patent investigations.

The Slide-rule. By C. N. Pickworth. 132 pages, 5 by 7 inches. Published by the D. Van Nostrand Co., 8 Warren St., New York City and by Emmott & Co., Ltd., 20 Bedford St., W.C., London, England. Price, $1.50.

This is the seventeenth edition of a work treating of the construction and use of the slide-rule. The new edition contains some slight revisions and a description of new types of slide-rules. The book contains a brief resume of the principles of logarithmic calculation on which the slide-rule is based. It describes the mathematical and mechanical principles of the slide-rule and gives an outline of the development of the modern slide-rule from the primitive type. A detailed description of the slide-rule is given, as well as instructions for using it on the following operations: Multiplication, division, proportion, finding squares and square roots, cubes and cube roots, miscellaneous powers and roots, trigonometrical application and special calculations. One section of the book gives examples of technical calculations made by use of the slide-rule, such as finding the velocity in feet per second of a falling body, finding the centrifugal force of a revolving mass, finding the piston speed of steam engines, etc. A number of special types of slide-rules are also described. The appendix contains descriptions of new types of slide-rules, solution of algebraic equations, screw-cutting gear calculations, and gage points and signs on slide-rules.

Training Industrial Workers. By Roy Willmarth Kelly. 437 pages, 5½ by 8½ inches. Published by the Ronald Press Co., 20 Vesey St., New York City. Price, $5.

The author of this book is manager of industrial relations of the Associated Oil Co. of California, and the subject matter is therefore based on actual experience in training labor, as well as on visits which the author has made to business concerns and schools in many different parts of the United States, numerous conferences with employment managers and school officers, and experience gained as principal of a technical high school and director of part-time courses in employment management. The book describes and explains vocational education, specialized work, apprenticeship, rating systems, and many other problems relating to the training of industrial workers. It points out the great need for industrial training at the present time, and shows the economic and social losses resulting from lack of this training. Successful accomplishments in vocational education are reviewed and reasons for their success are given. The volume presents a survey of various types of schools and classes, and gives illustrations of their work. Emphasis has been laid upon training which can be accomplished within plant and cooperative schools, minor attention being given to continuation schools and trade schools. A chapter is devoted to the educational value of democratic participation in management, in which are discussed such points as collective bargaining, employe representation, cooperative activities, etc.

Heat Engines. By D. A. Low. 592 pages, 6 by 9 inches; 656 illustrations. Published by Longmans, Green & Co., Fourth Ave. and 30th St., New York City. Price, $6.50, net.

The subject of heat engines embraces a wide field and it would not be possible to cover the whole ground adequately in a single volume. The author has attempted in the present work to present sufficient material for a two years' course in the subject. The text has been written on the assumption that the student will spend considerable time in working out the numerous exercises which are given. An attempt has been made to combine the theoretical and practical sides of the subject, but attention is called to the fact that it is necessary for the student to supplement the material presented with practical experience and a knowledge of the details of construction of heat engines and their accessories. Such experience can, of course, be gained in the engineering laboratories of schools and colleges. The material is presented in twenty-four chapters covering the following subjects: Heat and Work; Expansion and Compression of Gases; Properties of Steam; Ideal Heat Engine Cycles; Combustion and Fuel; Steam Boilers; Steam Boiler Details; Steam Boiler Mountings; Steam Boiler Accessories; Natural and Artificial Draft; Performance of Steam Boilers; Reciprocating Steam Engines; Reciprocating Steam Engine Details; Hypothetical Indicator Diagram Problems; Indicators and Indicator Diagrams; Crank Effort Diagrams and Flywheels; Governors; Valves and Valve Gears; Performance of Reciprocating Engines; Steam Turbines; Condensers and Air Pumps; Internal Combustion Engines; Theory of Internal Combustion Engines; and Performance of Internal Combustion Engines.

Elements of Mechanism. By Peter Schwamb, Allyne L. Merrill, and Walter H. James. 372 pages, 6 by 9 inches. Published by John Wiley & Sons, Inc., 432 Fourth Ave., New York City. Price, $3.50.

The main material of this work which is now in its third edition, was written in 1885 by Peter Schwamb, and has been in use since that time in the Massachusetts Institute of Technology, as a basis for instruction in mechanism. Professor James, who has charge of the instruction in mechanical engineering drawing and machine drawing at the institute and who has also been an instructor in mechanism for many years, has had charge of the present revision of the book. The revised edition embodies many changes suggested by instructors who have made use of the second edition during the last sixteen years. The subject matter is not original, having, of course, been covered by previous writers, but a careful selection has been made of the most essential material, and the aim has been to present it in a systematic, clear, and practical manner. The last section of the book contains 152 problems

for the student to work out in order to gain a more comprehensive idea of the principles expounded. The following chapter headings will give an idea of the points covered: Revolving and Oscillating Bodies; Belt, Ropes, and Chains; Transmission of Motion by Bodies in Pure Rolling Contact; Gears and Gear Teeth; Wheels in Trains; Epicyclic Gear Trains; Inclined Plane, Wedge, Screw, Worm and Wheel; Four-bar Linkage—Relative Velocities of Rigidly Connected Points; Linkwork; Straight-line Mechanisms—Parallel Motions; Miscellaneous Mechanisms—Aggregate Combinations—Pulley Blocks—Intermittent Motion; Problems.

NEW CATALOGUES AND CIRCULARS

Monarch Machine Tool Co., 109 Oak St., Sidney, Ohio. Circular containing illustrations and specifications for Monarch 10-, 12-, 14-, 16-, 18-, 20-, 24-, 26-, 28-, and 30-inch engine lathes.

Nicholson Power Devices Co., 28 N. Clinton St., Chicago, Ill. Circular descriptive of Nicholson steam engines; internal combustion motors; and air motors, pneumatic tools and pumps.

Cleveland Punch & Shear Works Co., Cleveland, Ohio. Circular giving dimensions of Cleveland rivet sets made in the following types: Button head, steeple head, pan head, Liverpool, and flush rivet sets.

Scalbom Mfg. Co., 11 S. Desplaines St., Chicago, Ill. Circular showing a die square and bevel gage for the use of diemakers and toolmakers in such work as transferring angles or taper holes.

United States Blue Print Paper Co., Inc., 327 S. La Salle St., Chicago, Ill. Circular showing a number of the drawing instruments of the Richter line, including compasses, dividers, drawing pens, etc.

Ingersoll Milling Machine Co., Rockford, Ill. Circular illustrating installations of Ingersoll drum type continuous milling machines, which have been made to meet special intensive production problems.

Giddings & Lewis Machine Tool Co., Fond du Lac, Wis. Circular containing specifications and a list of special features of the Giddings & Lewis No. 25 horizontal boring, drilling and milling machine of the table type.

Dyneto Electric Corporation, Syracuse, N. Y. Pamphlet illustrating and describing the Dyneto Type UM-D "Utility" motor, having a rating of ¼ horsepower, for operation on a 32-volt current, at 350 to 2000 revolutions per minute.

Pittsburg Instrument & Machine Co., 40 Water St., Pittsburg, Pa. Pamphlet descriptive of a continuous and alternating impact testing machine for use in testing airplane, automobile, and other machine parts that are exposed to shock.

O. K. Clutch Machinery Co., Columbia, Pa. Circular containing descriptive matter, tables of dimensions, and price lists of O. K. friction clutch pulleys for gasoline and oil engines, O. K. friction clutches, and O. K. cut-off couplings.

Norton Co., Worcester, Mass. Catalogue of Norton alundum and crystolon refractories for scientific and industrial work. The booklet gives data concerning the properties of alundum and crystolon, and contains tables of dimensions, prices, etc.

Whiting Corporation, Harvey, Ill. Catalogue 156, illustrating and describing the construction of "helical-worm" geared crane ladles, truck ladles, and other types of foundry ladles made by this company. Copies of the catalogue will be sent upon request.

Wagner Electric Mfg. Co., St. Louis, Mo. Bulletin 124, descriptive of Wagner instrument transformers for application to switchboards and other alternating-current instruments. Bulletin 125, of Wagner single-phase motors, containing instructions for ordering and adjusting repair parts.

Frontier Machine Tool Co., Inc., Buffalo, N. Y. Catalogue illustrating and describing the Frontier "Super-drill," which is equipped for either belt or motor drive and has a swing of 20 inches. The pamphlet also gives specifications for the Frontier power hacksaw machine and tool grinder.

Cutler-Hammer Mfg. Co., Milwaukee, Wis. Booklet 850, treating of Cutler-Hammer shoe brakes for direct- and alternating-current service. Tables give dimensions and ratings of each type of brake, and it is explained how the correct size of brake for any particular installation may be calculated.

Diamond Machine Co., Providence, R. I. Catalogue of the Diamond surface grinding machine, containing a large number of illustrations showing typical examples of work for which this machine is adapted, and giving information concerning the materials, grinding times, limits of accuracy, etc.

Firth-Sterling Steel Co., 310 Hudson St., New York City, manufacturer of "Blue Chip" high-speed steel and other tool and die steels, is distributing a card showing heat-treatment colors and the approximate temperatures at which they appear. The back of the card contains a decimal equivalent table.

Crouse-Hinds Co., Syracuse, N. Y. Circular showing installations of conduit outlets known as "Condulets," which are made in a number of types for a wide variety of uses. These "Condulets" are equipped with covers designed to protect push-button switches against vapor, gas, dust, moisture, etc.

N. B. Payne & Co., 25 Church St., New York City. Circular of material-handling machinery, including overhead electric cranes and hoists, portable elevators, conveyors, pilers, and car loaders, showing twenty-seven views illustrative of the labor-saving possibilities of these different types of equipment.

Miller & Crowningshield, Greenfield, Mass. Circular containing description and specifications for Miller & Crowningshield multiple-spindle index-centers, used for production work in fluting and squaring taps, reamers, etc. The various centers for fluting and squaring index-heads are shown in diagrammatic form.

Neil & Smith Electric Tool Co., Cincinnati, Ohio. Drill bulletin No. 9, giving specifications for the different sizes and types of universal current single- and two-speed portable electric drills, and single- and two-speed direct-current drills. Several portable grinders and grinding attachments are also illustrated.

Northern Engineering Works, Detroit, Mich. Catalogue 28, containing views of a large number of installations of Northern electric traveling cranes, bridge and gantry cranes, and other electric, pneumatic, and hand power types of cranes. Several types of electric crane trolleys and electric traveling cranes are illustrated and described.

Gould & Eberhardt, Newark, N. J. Bulletin 78, illustrating the use of Gould & Eberhardt shapers in railroad shops. The circular shows several views of these machines engaged on typical railroad shop work, and gives a list of special features of the high-duty 16-, 20-, and 24-inch shapers and "Invincible" 28-inch shapers, which are made with either belt or motor drive.

Tem-Pro Steel Co., Plymouth Bldg., Cleveland, Ohio. Booklet treating of "Tem-pro" compound —a patented compound for use in hardening high-speed and carbon steels. The book treats of the characteristics of the compound, and contains suggestions for treating high-speed and carbon tool steels, as well as directions for using "Tem-pro" compound in hardening both high-speed and carbon tool steels.

Hanson Clutch & Machinery Co., Tiffin, Ohio. Catalogue C-3 of Hanson friction clutches. The booklet shows applications of this type of clutch to meet different conditions of speed and other requirements of machine design and transmission of power. Tables are given listing the dimensions of the different sizes, their horsepower, weights, etc. Dimensions and other data are also given for Hanson countershafts, countershaft clutch pulleys, and machine clutches.

Frank D. Chase Co., Inc., Chicago, Ill. Booklet entitled "Factories that Fit," illustrating forty representative plants in various parts of the country designed by this company. The purpose of the book is to show the manufacturer the necessity of having his plant so fitted to the work it is to do that the processes of manufacture can be accomplished in an orderly fashion and with the least labor cost. Copies will be sent upon request.

W. B. Knight Machinery Co., St. Louis, Mo. Circular entitled "What Others Think of Knight Millers," illustrating the No. 3 Knight milling and drilling machine, and showing its application for tool and die work, pattern work, and production manufacturing work. The pamphlet contains facts concerning the actual operation of this machine in various plants, information being given concerning the work accomplished and the production attained.

Stanley Belting Corporation, Department A, S. Clinton St., Chicago, Ill. Booklet entitled "A Saving for Every User of Belting," treating of the characteristics of Stanley solid woven cotton belting. A list of typical installations for which this type of belting is especially well adapted is given, and its use on different classes of machines is illustrated. Figures are also given covering tensile strength for single, double and triple belts running at from 200 to 5000 feet per minute.

Davis-Bournonville Co., Jersey City, N. J. Pamphlet containing a paper entitled, "Oxy-acetylene Welding on Refrigerating Apparatus," by Fred E. Rogers, read before the December meeting of the American Society of Refrigerating Engineers. The paper describes the use of the oxy-acetylene welding process in making refrigerating apparatus, giving information on preparing work for welding, manipulation of torch and welding rod, penetration, reinforcement of welds, etc.

Smalley-General Co., Bay City, Mich. Circular illustrating the Smalley-General No. 23 hollow-spindle thread and form milling machine, designed for milling either internal or external, right- or left-hand, straight or taper, single or multiple threads of any form. Leaflet containing twelve time studies of jobs performed on Smalley-General thread milling machines, giving data relating to the material operated upon, dimensions of part being machined, time, etc.

Skelton Tool Co., Syracuse, N. Y., manufacturer of reamers and special tools, has issued a catalogue describing taper reaming tools, including the Skelton patent roughing reamers, helical finishing reamers, taper pin reamers, and bridge reamers. The catalogue explains the new method of taper-reaming made possible by the Skelton taper reamers, and contains instructions for grinding helical reamers and roughing reamers. The reamers described are new departures in reaming practice and have proved very efficient as production tools.

National Tube Co., Pittsburg, Pa. Bulletin 15C, devoted to the use of National pipe in the oil industry, as casing for oil, gas, water, etc. The book gives a brief outline of the development of well sinking from the earliest period, discusses improvements in drilling equipment and modern drilling methods, and contains an article on the rotary method of well-drilling. The advantages of National pipe for drilling purposes are listed, and information is given on the characteristics of National pipe, threading operations, construction of joints, etc.

McCrosky Tool Corporation, Meadville, Pa. Catalogue 8, illustrating and describing McCrosky adjustable reamers equipped with carbon and high-speed steel blades; "Wizard" quick-change chucks and collets, and variable-speed and reversing attachment; turret attachments for lathes; steadyrests; milling machines; and "Searchlight" lamp brackets. The catalogue shows a number of important improvements in the McCrosky tools and describes several new tools which have been recently added to the line. Price lists are also given of the various products.

Griscom-Russell Co., 90 West St., New York City, has recently published a 29-page illustrated booklet entitled, "The Cooling of Quenching Oil in the Heat-treatment of Steel," by Kenneth B. Millett. The book describes the necessity for heat-treatment, the various quenching mediums and systems commonly used, the advantages of continuous circulation of the medium, and the adaptability of the "Multiwhirl" cooler to the cooling of quenching oil. Typical installations are featured, showing the lay-out of the piping with recommendations for the proper size and number of coolers to meet the requirements.

Velco Mfg. Co., Inc., Greenfield, Mass., has prepared and is distributing a booklet entitled "The Use and Care of the Broach," the purpose of which is to educate the broaching machine operator and foreman in the proper use of the broaching machine and broaching tools. Among the subjects treated are the following: Broach Terminology; Selecting the Proper Broach; Preparing the Work for the Broaching Operation; Setting up the Broach in the Broaching Machine; and Lubrication. A number of broaching kinks developed in actual practice are given, and the foreman will find the section devoted to successful broaching jobs and production obtained particularly interesting. Copies of the booklet will be sent to mechanics upon request.

Skinner Chuck Co., New Britain, Conn. Booklet entitled "Chucks and Their Uses," intended to offer the machinery buyer, machinery salesman, student, apprentice, and mechanic a compact easily understandable and authoritative fund of information on standard types of chucks and their uses. The booklet begins with a history of chucks and the story of their development, which is followed by a detailed description of the various types of chucks and their uses. Suggestions are made regarding the proper way to fit a chuck to a lathe and the care of the chuck, and a number of "don'ts" are given for chuck users. It is the intention of the company to distribute these booklets without charge to anyone interested in chucks. Copies will be sent to factory managers and superintendents for distribution in their shops, upon request.

Taft-Peirce Mfg. Co., Woonsocket, R. I. Bulletin 112, giving detailed instructions concerning the use of the Martell aligning reamer, for line-reaming and sizing crankshaft bearings. A general description of the reaming equipment is given and standard and special sizes are listed. The working instructions cover the care of the aligning reamer, setting up, adjusting centering bushings, adjusting the reamer, the reaming operation, and general rules. Bulletin 113 of Taft-Peirce thread gages, containing tables of dimensions for the various standards. The subject of measuring threads is discussed, attention being given to both the three-wire and three-ball methods. The last section of the book contains a reproduction of the National Screw Thread Commission's report on screw thread standards, including tables of allowances and tolerances.

Edward R. Ladew Co., Inc., 428 Broadway, New York City, manufacturer of Hoyt's "Flintstone" belting, and other leather products, has published a book entitled "The Proof Book," containing an outline of the history, standards, and policies of the concern, which has been in business since 1835. The booklet also contains a brief discussion of the belting problem and some of the fundamentals of belting economy. The illustrations show actual installations of Hoyt belts, which have been in service for varying

periods up to forty-four years. Catalogue of leather belting, containing eighty pages descriptive of the manufacture of Hoyt leather belting from the rough hide to the finished product. Belting rules and tables are given, together with a data sheet for the analysis of belt drives to secure the highest economy. Data relating to belting accessories are also included.

Pratt & Whitney Co., Hartford, Conn. Circular 259, descriptive of the curvex milling cutter—a formed milling cutter with spiral teeth and eccentric relief. A brief description and specifications for the curvex cutter grinder are included. Catalogue 260—Operators' Handbook for the curvex cutter grinder. This book is published to assist users of the Pratt & Whitney curvex cutter grinder in the operation and maintenance of the machine, and to insure that they obtain the quality of work of which the machine is capable. A detailed description of the construction and operation is given, together with instructions for setting the machine for grinding. The repair part section of the catalogue contains line illustrations of the various parts of the machine, which are numbered so as to facilitate ordering when replacement of any of the parts becomes necessary. There are eleven pages of tables giving the proper change-gears to use for the entire range of leads.

Vulcan Crucible Steel Co., Aliquippa, Pa. Catalogue 6, showing the various classes and types of steels manufactured by this company, as well as interior views of the plant, illustrating some of the steps in the production of steel. Information is given relating to the hardening, drawing, and special uses of each brand, and fracture photographs are reproduced showing the effects of correct and incorrect hardening. The book also treats of the tempers of the various tool steels produced. One section relates to hardening furnaces and pyrometers. Other subjects treated are drawing baths, hardening baths, fractures, and effect of time on drawing. A list is given of a large number of tools, such as cutters, dies, lathe tools, reamers, taps, etc., and the grade of steels recommended for making them. The catalogue concludes with tabular matter, such as weights of carbon steel, weights of high-speed steel, and physical tests on steel, showing elastic limit, tensile strength, elongation, reduction in area, etc.

Hendey Machine Co., Torrington, Conn., has published for free distribution to users of Hendey lathes, an operator's handbook, treating of the construction of these lathes and containing instructions relating to their operation. A view of the lathe is shown on the first page, with the various parts numbered, the designation of the parts being given on the page opposite the illustration. Then follows an illustrated description of the head spindle and bearings, geared drive head, apron, and related mechanism. The next section entitled "Helps on Change-gearing and Thread-cutting," contains a description of the change-gear mechanism and the standard index-plates, showing range of threads and feeds, and gives formulas for figuring gears for thread-cutting. Special index charts are given, showing a series of different pitches obtained with extra change-gears through the whole thirty-six change combination, for the different sizes of lathes. The relieving attachments for use on Hendey lathes are described, and special directions are given for various classes of relieving, such as the relieving of taps, formed cutters, angular cutters, counterbores, etc. Copies of the book can be obtained either from the main office, or from any of the branch offices or agencies.

TRADE NOTES

American Emery Wheel Works, Providence, R. I., manufacturer of corundum and carbolite wheels, has increased its capital stock from $100,000 to $1,000,000.

Cutler-Hammer Mfg. Co., Milwaukee, Wis., announces that an approximate reduction of 10 per cent on all controller prices was effected February 14 by a change in discounts.

Delta File Works, 3231 Frankford Ave., Philadelphia, Pa., has outgrown its present quarters and moved into a new plant at Tacony and Bockius Sts., Bridesburg, Philadelphia, which will afford four times the previous floor space.

Rotterdamsche Machinehandel, Esmeijer & Co., Rotterdam, Holland, announce that during the past year they have extended their show-rooms and warehouses to a considerable extent, so that the floor space now covers over 60,000 square feet.

Cleveland Machine Tool Co., Cleveland, Ohio, has given up its leased factory on Superior Ave. and moved into its own plant at 18511 Euclid Ave., which will afford increased facilities for manufacturing the Cleveland horizontal boring machine.

Precision & Thread Grinder Mfg. Co., Inc., 1 S. 21st St., Philadelphia, Pa., announces that the multi-graduated precision grinder of its manufacture has been arranged to give two grinding wheel spindle speeds, of 6000 and 12,000 revolutions per minute.

Chicago Flexible Shaft Co., 1154 S. Central Ave., Chicago, Ill., has opened a Detroit office for the sale of Stewart furnaces and to give service and advice in heat-treating problems to customers in that territory. The new office will be located at 601 Kerr Bldg., and will be in charge of George P. Beck.

Adamson Mfg. Co., East Palestine, Ohio, manufacturer of Adamson vulcanizers, automobile accessories and specialties, has added a new department for manufacturing all kinds of storage, pneumatic and pressure tanks, welded pipe, battery casings, evaporators, condensers, and a large line of arc-welded products.

Promptitude Machine Works, 1000 W. Randolph St., Chicago, Ill.—a partnership formed by Fred E. Cutter, Charles J. Hosmer, and Charles G. Norberg—has been dissolved, and it is announced that Charles G. Norberg of 553 W. Lake St., Chicago, has assumed full responsibility for all assets and liabilities of the company.

Purves Mfg. Co., Syracuse, N. Y., maker of oil-cups, special tools, and machinery, has just moved into its new shop at 311 Almond St. The new shop is of concrete block construction, with excellent light, and will materially increase the company's manufacturing capacity and enable it to meet the growing demand for its products.

Greenfield Tap & Die Corporation, Greenfield, Mass., has bought the interests of the **Lincoln Twist Drill Co.** and has now included the line made by the latter company as part of its regular product. Ralph Barstow, formerly sales promotion manager, is now general sales manager for the Greenfield Tap & Die Corporation industries.

Landis Tool Co., Waynesboro, Pa., manufacturer of cylindrical grinding machines, announces that beginning March 1 the company will make a general reduction in prices on all its machines, with the exception of the crankshaft grinding machine. The reduction will average 15 to 20 per cent on the company's entire product, with the exception noted.

Edward R Ladew Co., Inc., 428 Broadway, New York City, tanner and leather belt manufacturer, has closed its sales office at Charlotte, N. C., and transferred its southern headquarters to 95 S. Forsyth St., Atlanta, Ga. An ample stock of belting and leather specialties will be carried, with the usual facilities for special work and engineering service.

Hooven, Owens, Rentschler Co., Hamilton, Ohio, manufacturer of Hamilton engines and machinery, has appointed the John Fensom Co., Richmond, Va., as its representative in the Virginia territory; the Sunderland Machinery & Supply Co., Omaha, Neb., as representative in the Omaha district; and Walter T. Paine as representative in the Boston district.

Austin Machinery Corporation of Louisiana, Inc., 1020 Maison Blanche Bldg., New Orleans, La., announces its incorporation under the laws of the state of Louisiana as sole distributor for the products of the Austin Machinery Corporation, manufacturer of earth-moving and concrete mixing machinery, in the states of Louisiana, Arkansas, Mississippi, and Tennessee.

Black & Decker Mfg. Co., Towson Heights, Baltimore, Md., has opened a new branch office and service station at 75 Fremont St., San Francisco, Cal., to take care of the business in the Pacific coast territory. A complete stock of parts will be carried in the new office, and a factory trained mechanic will be on hand to give service to users of Black & Decker products in that territory. M. A. Johnson will be in charge of the new office.

Hubbard Machine Co. announces that it has entered into an agreement with the S K F Industries, Inc., under the terms of which the sales of Hubbard products will hereafter be conducted by the S K F Industries, Inc., 165 Broadway, New York City, to whom all correspondence relating to the business and engineering service should be addressed. The factory of the Hubbard Machine Co. has been moved from Worcester, Mass. to Hartford, Conn.

Cincinnati Milling Machine Co., Cincinnati, Ohio, announces that it has become financially interested in the **Cincinnati Grinder Co.** It is purposed to manufacture the latter company's line of universal and plain cylindrical grinding machines and internal grinding machines in the plant of the Cincinnati Milling Machine Co., to which extensive additions have recently been made. The marketing of the grinding machines will be carried on as heretofore through the Cincinnati Grinder Co.

N. B. Payne & Co., 25 Church St., New York City, dealers in electric cranes and hoists, have extended their lines of material-handling machinery to include the portable conveyors made by the A. C. Warner Co., Philadelphia, Pa., Chicago automatic coal elevators, and McKinney-Harrington package pilers and car loaders. Edmund Otto, for several years secretary of the Hardware & Supply Co. of New York City, and prior to that associated with Manning, Maxwell & Moore, Inc., also of New York City, is now connected with N. B. Payne & Co., in this branch of their business.

Consolidated Instrument Co. of America, 461 Eighth Ave., Printing Crafts' Bldg., New York City, has been organized to render engineering and sales service in connection with all types of speed indicating and recording instruments and devices. The company controls exclusively the entire American distribution of the Jones tachometers, and also distributes exclusively throughout the United States the Hasler speed indicator and "Tel Speed" recording devices. All correspondence with reference to the Hasler products should be addressed direct to the Consolidated Instrument Co.

Weigel Machine Tool Co., Peru, Ind., manufacturer of the Weigel upright drilling machine, has recently been reorganized. The new officers are H. B. Fox, president; C. E. Redmon, vice-president; G. E. Meck, secretary; C. L. Weigel, assistant secretary; and H. P. Sullivan, treasurer and general manager. C. L. Weigel is also production manager and purchasing agent. The capital stock has been increased to $145,000. This line of drilling machines was originally designed by Alfred L. Weigel, who died in September, 1919; the original Weigel design has been maintained and several improvements have been made in the new line now offered.

Standard Machinery & Supply Co., Inc., 924 First Ave. South, Seattle, Wash., has purchased the assets and stock of the **Chicago Machinery & Equipment Co.** of Seattle, which has been prominently identified with second-hand machinery lines for a number of years. It is the plan of the company at present to continue the second-hand wood- and iron-working machinery lines, and in addition new machines will be featured. Mr. Buchner, the president of the company, has been for the last nine years sales manager of the Perine Machinery Co. of Seattle. Charles M. Weinberg, previously associated with the Dodge Sales & Engineering Co., has joined the company.

Reed-Prentice Co., **Becker Milling Machine Co.**, and **Whitcomb-Blaisdell Machine Tool Co.** announce that their executive, sales, purchasing, and accounting departments are now located at the Reed-Prentice plant, 677 Cambridge St., Worcester, Mass. On account of present business conditions the Becker plant at Hyde Park, Boston, is operating with reduced force, but production will be increased as soon as conditions warrant. The Becker cutter department business showed a marked increase in volume during January, and it is expected to be running full capacity shortly. The Worcester plants of the Reed-Prentice Co. and the Whitcomb-Blaisdell Machine Tool Co. are completing orders on hand and also building machines for stock.

Toledo Crane Co., Bucyrus, Ohio, has been duly chartered under the laws of Ohio as successor to the **Toledo Bridge & Crane Co.** of Toledo, builder of Toledo cranes. The company expects to have completed by March 15 a building, 120 by 320 feet, for erecting and assembling, which, together with a machine shop, 60 by 300 feet, a structural shop, 90 by 300 feet, a pattern shop, 60 by 140 feet, and a forge shop 40 by 100 feet, will give the company adequate facilities to continue the same service to its customers as it has rendered in the past. The officers are C. F. Michael, president; W. F. Billingsley, vice-president and general manager; A. G. Stoltz, treasurer; and C. Gallinger, secretary. The main office will be located at Bucyrus, and sales offices will be maintained in New York City and the other principal cities of the country.

McKay & Sherman, 741 Monadnock Block, Chicago, Ill., is a new partnership formed by Charles W. McKay and P. C. Sherman, for the practice of the engineering evaluation of industrial and public utility properties. The firm will also specialize in the preparation of valuations and financial reports for investment bankers. Mr. McKay is the author of a book entitled "Valuing Industrial Properties," published in 1918. During the past year he has written over 100 articles for technical and trade journals on the general subject of valuation. He is a member of the advisory council of the Industrial Extension Institute, and during the past two years has supervised the appraisement of over $100,000,000 worth of industrial and public utility properties. Mr. Sherman, the vice-president of the company, is president of Sherman & Associates, Inc., of New York City.

Meldrum - Gabrielson Corporation, Syracuse, N. Y., has been formed by Alexander Meldrum, Carl Gabrielson, and A. J. Littlejohn, who have taken over the entire ownership of the Meldrum-Semon-Greiner-Lowry Co., Inc., of Syracuse, which business will henceforth be conducted under the name of the Meldrum-Gabrielson Corporation. The new corporation has also arranged with the Gabrielson Mfg. Corporation for the exclusive manufacture and sale of the Gabrielson milling machine, a new departure in manufacturing milling machines. The company will also continue to manufacture the Syracuse adjustable limit snap gages, and will also devote itself to the building of special machinery and tools, for which purpose its plant is particularly equipped. A designing department is added as a new feature of this branch of the business. Mr. Gabrielson will serve as consulting engineer, and Mr. Meldrum will continue as general manager, while Mr. Littlejohn will take charge of the sales of the company's products.